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**Understanding University of Technology Foundation
students' perspectives on their learning in Mathematics,
with a focus on group work**

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the award of the degree

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COMPULSORY DECLARATION

This work has not been previously submitted in whole, or in part, for the award of any degree. It is my own work. Each significant contribution to, and quotation in, this dissertation from the work, or works, of other people has been attributed, and has been cited and referenced.

Signature:.....signature removed.....Date: 15.02.2008.....

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To my mother, Safia

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ABSTRACT

This study investigates students' perceptions of their learning experiences at the Cape Peninsula University of Technology (CPUT) as well as their perceptions of their previous high school learning experiences. Eight first time entering Black township-schooled foundation Civil Engineering students were interviewed.

The students indicated that they had difficulties with the medium of instruction, English. It also appears that certain teaching and learning practices at school do not prepare students for study at a tertiary institution. Social factors, such as transport and residence issues, were also named as issues influencing students' learning.

An important focus of the study was on students' perceptions of group work, since the study took place during a period in which a group work intervention was conducted in the class from which the eight participants were selected. Seven of the eight participating students in the study made use of some form of group work at high school. The students had a positive disposition towards group work at school and towards the group work intervention programme at CPUT. They also had particular views of what group work is. The study also claims that students benefited from group work and that group work had a positive effect on students' performances in Mathematics.

This study advocates for and contributes to a theoretical perspective on student communities, an aspect of the community perspective (Allie et al., 2007) on student learning. Group work as a form of participation that was investigated in this study was beneficial in student learning. Thus the theoretical perspective for the study, student communities, is appropriate. The study makes a contribution to the existing theoretical perspective in that it provides some insight into the school communities from which students entering higher education come; it suggests what classroom communities at tertiary level might look like; and it argues for the importance of the development of student communities outside the classroom.

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CHAPTER 1: INTRODUCTION

1.0 Orientation to the study

The topic of this study is one that is becoming increasingly important in the emerging South Africa. Instead of attempting to conduct a small-scale study on a specific small quantifiable aspect of the problem, I have approached the issue of underpreparedness of university of technology¹ (UT) students in Mathematics by investigating the learning experiences of a small group of students in one of my classes. I did so because my intention is not to be in a position to make general conclusions at the end of this research but rather to contribute to what I believe is an important academic conversation that has been started by academics working closely with the Centre for Research in Engineering Education (CREE) at the University of Cape Town. I will draw from hermeneutic thinking (Davis, 1996) to open up my research question for exploration and understand that this might end up with my having more questions than I had at the beginning. I will also locate myself within the research by allowing the reader to see how my lived experiences have positioned me and influenced my structure which Davis (1996) defines as enactivism.

Rather than follow the more conventional route of first deciding on a theoretical framework and then interrogating the data against this self-same framework, I am going to allow the data and the theoretical framework to interact with each other in the process of the research following the model of complexity thinking research (Davis & Sumatra, 2006).

1.1 The national context for this study

South African universities and (UTs) have low pass rates by international standards (Scott, 2006). According to Scott (2006) the throughput rate (that is, the number of

¹ These tertiary institutions were previously known as Technikons and were formed during a process of large scale restructuring in the Higher Education system.

students graduating) of engineering programmes at UTs is 9%. This figure represents the percentage of students, studying towards a three year diploma and graduating in four years. However, throughput rates are linked to the issue of access. Greater equitable access to higher education is of major transformation importance (Coughlan, 2006: 209). The widening of access to students, previously disadvantaged by Apartheid inequities, has resulted in students taking longer to graduate (Cele & Menon, 2006: 39). Apartheid education was characterized by 'social inequalities linked to educational difference and Apartheid-based social values' (Chisholm, 2003: 268). Since the first democratic elections in 1994, the new government has instituted measures to reform education. However, 80% of schools in South Africa are considered to be poorly performing and interventions to improve these schools have proved to be inefficient (Taylor, 2006: 1). Township schools are known to have problems with lack of resources, student and teacher late-coming and absenteeism, and poorly qualified teachers (HSRC², 2000).

Cele and Menon (2006: 39) argue that the failure by higher education institutions to find a balance between 'equity of access' and 'equity of outcomes' results in the continued exclusion of historically disadvantaged people from participating in the wider economic and social spheres of the country. Referring to the link between poor throughput rates and access to tertiary institutions, the Minister of Education has stated that 'access without a reasonable chance of success is no access at all' (The Cape Argus, 2008: 4).

Foundation programmes in South Africa are seen as initiatives by universities to tackle issues of access and retention of previously disadvantaged students whose prior learning has been adversely affected by educational or social inequalities (Kloot, Case & Marshall, 2007: 1).

Foundation programmes originated in the late 1970s (Volbrecht & Boughey, 2004: 59). These programmes, then known as academic support, started at mainly white English speaking universities, aimed to support the few black students that managed to gain entry to these institutions and who were considered to be disadvantaged. The support provided

² Human Sciences Research Council

was in the form of add-on tutorial or special courses. A shift occurred from academic support to academic development (AD) in the late 1980s (Volbrecht & Boughey, 2004: 62). The focus in academic development was to enable the institution to meet the demands of a changed student population in general in comparison to academic support in which students were marginalised. Academic development work shifted from specialised units to the mainstream, albeit still in a marginalised role (Volbrecht & Boughey, 2004: 65). A further change noted by Volbrecht and Boughey (2004: 66) is a change from AD to what is known as Higher Education Development with its focus on transformation (in Higher Education). However, the term AD is still in use. The curricula in AD programmes are usually of the form where the subjects are in part academic support and in part the mainstream subjects, and are taught over a longer period than that of the mainstream subjects. This is still the case in most of these programmes. Many of these programmes have become known as Extended Curriculum Programmes (ECPs).

Since this study took place at the Civil Engineering Department at the Cape Peninsula University of Technology (CPUT), I shall refer mainly to foundation programmes in engineering. I am well aware that other fields, in particular the Sciences also have huge problems with access, retention and throughput as can be seen in the low throughput rates (Scott, 2006) and the number of foundation programmes in this field.

Other terms, such as bridging, have also been used to describe foundation programmes. This form of foundation is generally understood to imply repairing and the filling in of the backlogs of a poor school experience. This was provided by tertiary institutions or by private service providers. However, the term bridging, and other terms used to describe foundation programmes, do not necessarily describe what a foundation programme is essentially about. For example, between 1998 and 2004, I worked as a lecturer at the Leaf Programme which was recognised as a bridging college. However, it did not fit the description of a bridging programme but rather that of an ECP since most of the semester subjects were extended over a year. The academic support was provided within the credit-bearing subject (credit towards Diploma in Engineering).

Most of the foundational programmes add an additional year to the time of study. The structures of these programmes are varied. Some simply use the extra year to enable students to do fewer courses per year and thus more time to adapt and cope. Some programmes use the additional year to do mostly introductory work and skills development in the first year of study.

Some of these foundation programmes have been successful in terms of success rate, most notably the ASPECT programme at the University of Cape Town (UCT) (Pinto, 2001: 82) as well as the academic support programme in Engineering at the University of the Witwatersrand (Onsongo, 2006: 286).

The Technikon, North West (Gauteng Province) has had a foundation programme since 1986 (Pinto, 2001: 48). Most other Technikons started such programmes after 1992. The Leaf Programme was started in 1992, preparing students for university and technikons in the fields of Science, Engineering and Commerce. This was the only institution that offered foundation programmes for access to a technikon in the Western Cape Province in the 1990s. This programme and its sister programme, Access, which was located at the Peninsula Technikon³, were part of a non-governmental programme that aimed to provide access to students that otherwise would not have been able to study at a tertiary institution. The curriculum at the Leaf Programme was structured in an ECP format, that is, almost all the subjects were credit-bearing (towards Diploma in Engineering), semester subjects, extended over a year and was considered to be a successful one (Pinto, 2001: 33). The Leaf Programme has since closed down due to financial constraints and due to the competition from other institutions which have also instituted such programmes. The Peninsula Technikon's Civil Engineering Foundation Programme was started in 2002. The curriculum consisted of some credit-bearing and non credit-bearing courses.

³ Peninsula and Cape Technikons merged at the beginning of 2005 to form the Cape Peninsula University of Technology (CPUT). The institution, at the time of the study, had foundation programmes at both the previously merged institutions' campuses. This study took place at the Bellville campus of CPUT.

Foundational support, at present, is usually only given at first year level, however, there is some concern about these students' performance in later years and thus a need for support at second year level may have to be considered (Onsongo, 2006: 287).

The Department of Education (DoE, 2006) has responded to the problems of access and throughput by providing universities and UTs with additional funding to start or expand foundation programmes. However, the funding is dependent on the programme being an ECP. The funding of such programmes is more recent and universities had to financially sustain these initiatives themselves in the past. Kloot, Case and Marshall (2007:14) argue that the new phase of ECPs may yet be another means of 'tinkering' instead of bringing about the fundamental change that is required.

In summary, access, throughput and retention are issues that are serious concerns in higher education as was discussed at the beginning of this section. Foundation programme are intended to address some of these concerns. It is my opinion that it is necessary for institutions to learn from the successes of successful programmes, to focus on issues of teaching and learning, and to focus on research in this area. The intervention described in *Intervention programme*, section 1.4, is one such attempt to address some of the teaching and learning issues related to foundation programme students. This study, which is located in this intervention, is intended to contribute to research involving these students.

1.2 The researcher

I have been teaching Mathematics for the past twenty one years; first at high schools, teaching mainly at Coloured township schools in Cape Town. My high school teaching career lasted ten years. This period from 1987 to 1996 was characterised in the initial years by disruptions due to political unrest (these schools were drawn into the struggle against Apartheid) at Black and Coloured schools and later by the restructuring process in the school system which led to the retrenchment of thousands of teachers. These political interferences certainly impacted on the experiences of students. My own schooling and

tertiary studies at the University of the Western Cape (UWC)⁴ in Cape Town, between 1983 and 1986, was affected in a similar way by disruptions and political unrest.

My school teaching experience was followed by a year of teaching at the Peninsula Technikon mainstream programme, followed by six years of teaching on the Leaf Programme. The experience on the Leaf programme has been positive and fulfilling for me as a teacher since the programme provided access to many students, who otherwise would not have been able to enter a technikons, with a reasonable chance to do so. The one year programme was structured according to an ECP format with all subjects being credit-bearing and extended over a year. UT engineering mainstream subjects are semesterised. An extended subject in an ECP refers to the mainstream semesterised subject being done over a year.

I have been teaching Mathematics at CPUT (mainstream and foundation) since 2004. I have also, for the past two years, been involved with the administration and planning of the Civil Engineering Foundation Programme at CPUT. The CPUT's new foundation programme (Extended Curriculum Programme) structure was similar to that of the Leaf programme structure which required students to do the mainstream six months S1⁵ course in engineering over a period of a year.

My experience with the foundation programme at CPUT from 2005 to 2006 was one of frustration since I felt that the programme was not preparing students well enough for the mainstream programme. CPUT's new foundation programme, introduced in 2007, has a similar structure to that which the Leaf Programme had for several years.

My teaching methodology has been mainly teacher-centred and traditional. I would teach a section of work to the class, do example problems and give students exercises in class and for homework. This has been the case at school, at Leaf and at CPUT. However, at Leaf and at CPUT, I used informal group work at times as well as tutorial programmes

⁴ UWC was created during the Apartheid era for Coloured students.

⁵ UT engineering mainstream courses are semesterised. S1 refers to students in their first semester.

which involved students working in groups. The intention with the implementation of a group work intervention, discussed in section 1.4, *Intervention programme*, was motivated by a desire to improve my own classroom practice. I was also influenced by my observations of some students working together in class and forming study groups outside class time, as well as by my MEd studies during 2006 which introduced me to literature on the use of group work in tertiary education and the benefits that group work could provide, in particular, to foundation students.

1.3 The specific context for this research

1.3.1 The foundation programme at CPUT

In 2007 the format of the foundation programme in the Department of Civil Engineering, at CPUT, was changed. The old format had been in operation since 2002. The name of the programme changed from Foundation Programme⁶ to Extended Curriculum Programme (ECP). Students are registered for the Diploma in Civil Engineering (ECP).

The format changes were necessitated by a change in the way such programmes would be funded from the beginning of 2007 (DoE, 2006). The major difference between the two programmes was essentially that all courses in the new programme are credit-bearing whereas the old form consisted of a combination of credit-bearing and non credit-bearing courses.

For the new programme, the subjects that usually have low pass rates, such as Mathematics, Applied Mechanics and Drawing are extended over a year, instead of the six months in which these subjects are done in the mainstream, whilst the other subjects are done over a semester. The second semester mainstream programme will also be extended over a year for the ECP students.

⁶ This programme was replaced by the ECP, however, I shall still be using the term foundation programme to refer to the ECP and other such programmes.

1.3.2 Focus on the students

The class from which the participants for the study was selected, consisted of thirty five students of which twenty two were Black, eleven Coloured and two White students. The majority of the Black students originated from townships or rural areas where they had been schooled. The majority of the Black students spoke Xhosa⁷.

The entrance requirements for the foundation programme are a grade twelve, exit examination, pass with “D” symbols on standard grade for Mathematics and Physical Science, and an “E” symbol for English Second Language higher grade. Up until the end of 2007 most of the school subjects from Grade ten to twelve allowed a choice of grade (level) in a subject. Standard grade Mathematics refers to the level of a subject which requires an algorithmic approach to solving problems. On the other hand, Mathematics done on the higher grade requires a student to apply insight and a deeper understanding of the subject matter.

A study done by Pastoll (2007: 2) at CPUT claims that the grade twelve, exit examination, results are not an appropriate indicator for success in studying engineering and that there has been a ‘deterioration in quality’ of students entering engineering programmes over the last five years. His study shows that there is no correlation between grade twelve, exit examination, results and the marks achieved by students in Mechanics 1 at CPUT. The view expressed in this paper appears to be a deficit view of student learning since it only focuses on what is wrong with the students.

When students enter the UT they may be confronted by an educational system with different expectations to that which they have been familiar with, such as higher pass requirements, a higher standard of work, attendance and punctuality expectations and high study fees. The pass requirement at school is 33.33%; at the UT the pass requirement is 50%. Some of these students make use of substantial loans to finance their

⁷ Xhosa is an African language and is spoken by a large section of the population of South Africa. It is also one of the eleven official languages of South Africa.

studies and hostel accommodation. Some of them have to travel great distances to the CPUT campus using an ineffective transport system.

Another area of concern for students enrolling at CPUT to overcome is the medium of instruction. Since Xhosa is the home-language of most of the students, the medium of instruction, which is English, is an additional language to them. The problems encountered with learning in one's second or additional language have become the focus of attention amongst many educational researchers in South Africa (Setati, 2006) as it has been identified as having a major impact on achievement.

The language-in-education policy adopted in South Africa in 1997 not only allows schools and students to choose the medium of instruction, but the policy is also supportive of the use of languages other than English as the medium of instruction, and of language practices like code-switching (Setati, 2002:7). Despite the support for the use of home-languages in schools, the use of languages other than English as the medium of instruction is associated with inferior education (Setati, 2002:7). The use of English is associated with educational and socio-economic advancement and consequently parents want their children to be taught in English (Setati, 2002:8 & 2005: 1).

This preference for instruction in English amongst parents seems to be in conflict with Setati's (2002: 14) argument that the student's home-language is a useful resource for learning and teaching. Even though English is the medium of instruction in Mathematics at most of the students' high schools, the teachers often make use of code-switching when the English explanation is unclear (Setati, 2002:14). Code-switching, in this sense, refers to the switching from the medium of instruction, English, to the students' home-language.

The diverse experiences of students described in this section; poor preparation for studies at a UT, lack of career guidance and communication difficulties, are compounded by a low chance of success, as reflected by the low throughput rate, has been reported as

resulting in some form of (or feelings of) alienation of students from their studies (or from the institution) (Mann 2001; Case, 2008).

1.4 Intervention programme at CPUT

For ECP students, Mathematics 1 is a year course as opposed to the semester course for the mainstream students. In addition to the normal mainstream Mathematics 1 syllabus, the extended course covers sections of school Mathematics that are required for the Mathematics 1 syllabus. The course is also taught in such a way as to help students learn skills, ways of studying Mathematics and the general discourse of the subject.

At the beginning of the 2007 academic year, I began to implement group work in a Mathematics class with thirty five first year students in an extended curriculum programme in Civil Engineering at CPUT. The purpose of the intervention was in response to the need for change in the way that teaching and learning of Mathematics occurred. This was the first time that I introduced some form of formal group work in my classes. By formal, I mean that students work in groups throughout the class time. However, during the last few years preceding this study, I encouraged some form of informal group work when I noticed the benefits derived by some students, in particular, the weaker ones.

The subject that I teach is extended over a year instead of the six months in which the subject is taught on the mainstream. The amount of class time available for Mathematics is four hours per week. The time is divided into two one-hour sessions and one two-hour session. The size of the groups range from three to six students. Students are seated around hexagonal tables during all Mathematics classes. Only for assessment purposes are students separated. The class-time is characterised by phases of direct instruction by me, the lecturer, and students working with their peers. Less than half the time is spent on direct instruction with the remaining time spent by students working on and solving problems in groups. Since the Mathematics syllabus is algorithmic in nature, most of the

teaching and group work are taken up by working on exercises which come from a prescribed textbook and problems that I have taken from other books.

For the group work, I introduced the cooperative-base group type (Smith, Sheppard, Johnson & Johnson 2005: 95) of group work in the intervention programme. The main purpose of cooperative-base groups is that students are expected to work together on a long term basis to support each others' learning. This is a teacher-centred pedagogy since the content is taught by the lecturer. However, the intention is to reduce the direct teaching time and allow more time for students to work with their peers. In the 2007 intervention, the students were allowed to choose in which group they wanted to be, and sat at hexagonal-shaped tables so that they could face each other. Allowing students to choose their own group resulted in certain groups being stronger in terms of Mathematical performance than others. Most of the groups ended up being constituted along racial lines. The reason for allowing students to choose their own groups was to encourage them to make group work a part of their way of learning in their other classes, outside of class time as well as for those at student hostels to work together. I was concerned that by attempting to encourage racial integration by placing students in particular groups myself, students might not benefit as much as when the choice of group was made by themselves. Students might feel more comfortable working with students of their own choice as well as speaking the language of their own choice. Although my intention was not to intervene in their choice of group, I realised that certain changes were necessary in order for some of the groups to function better. In some cases this meant asking a better performing student to join a weaker group.

At the point of planning the intervention programme, I had not considered the effects of other aspects on student learning such as the communication difficulties that students seem to encounter or struggle with. Having introduced the particular intervention and being engaged with this particular study at the same time, as well as being aware that the overall aim of the research was to improve student learning, it became necessary to find out more about all issues that affected student learning. This process resulted in the focus of the study to change from being initially concerned with group work primarily to a

focus on student learning in general, in which group work became an aspect of the study; albeit still an important aspect.

There was a symbiotic relationship between the implementation of the intervention and the research study, described below in section 1.5, *The study and the aims of the research*, since both occurred during the same period. The one informed the other.

1.5 The study and the aims of the research

The intervention described in the previous section, was designed to introduce a particular form of group work in my foundation programme Mathematics class at CPUT. The related research study initially focussed on group work and the potential benefits that students could derive from participating in group work. However, during the initial study it became clear that many issues affected the learning of the students who participated in the study, and not only group work. Therefore, the aims of the research were broadened to include an understanding of the issues that affected the learning of the students. One of the initial reasons for undertaking the study was to improve my teaching and learning practice. The broadened research aims, in particular understanding students' school learning experiences, should be of value in order to understand students' learning problems as well as their beneficial learning experiences.

1.5.1 Research objectives

The following are the objectives of the research:

- to understand the factors that influence student learning at high school and at CPUT;
- to examine the impact that students' previous high school experiences have on their studies at CPUT;
- to investigate the similarities and differences with respect to teaching and learning at the students' previous high schools compared to that at CPUT;
- to investigate the use of group work at the students' previous high schools, if group work was used, as well as to understand what students understood group work to mean, and

- to examine the usefulness of the group work intervention at CPUT that is intended to assist student learning.

1.5.2 The research question

The main question of the research is:

What issues affect foundation student learning?

The sub-questions of the research are the following:

1. What teaching and learning experiences did students have at their high schools?
How different were these experiences at CPUT? What issues do students believe affected their learning at CPUT?
2. What experiences do students have of group work at school? Do students feel that group work benefits their learning? If it does benefit their learning, in what way?
3. Is the student communities perspective a useful perspective to describe foundation student learning?

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter presents an overview of the relevant literature that relates to specific aspects of the study. It will thus elaborate on various topics related to the learning problems encountered by students in the foundation programme, students' perceptions on issues that affect their learning and group work. The objective to explore these literature topics is intended to support the purpose of the study which relates to student learning and group work.

Since the setting of the study is higher education, I have mainly focussed on literature in this area. However, where necessary and appropriate or when literature on certain issues was difficult to find, I made use of appropriate literature on high school learning. Although the study is focussed on students studying Mathematics in an engineering discipline, I made use of literature in other disciplines as well.

2.2 Issues affecting student learning

2.2.1 School preparation for studies at tertiary institutions

Universities of Technology (UTs) have problems with the readiness of first time entering students for tertiary study. A study by Pastoll (2007: 2) claims that the grade twelve, exit examination results are not a good indicator for success at a UT and that many of the students that CPUT's Engineering programmes are attracting do not have the necessary skills to study engineering. The argument by Pastoll is supported by a study done by Leigh and Buffler (2004: 528) at CPUT. They advance that first time entering students studying Physics have poor numeracy and problem solving skills, as well as poor attitudes to the learning of Physics. Another study done at the then University of KwaZulu-Natal indicates that first time entering students, with the required grade twelve, exit examination prerequisites, seem to have lower competence levels in Mathematics than in the past (Campbell, Anderson & Ewer, 2003: 342). This study recommends that

educators should be aware of the poor Mathematical abilities of first time entering students and should take steps to address the problem. The assumptions that students are adequately prepared for university studies, may result in students experiencing conceptual and reasoning difficulties with new work (Campbell, Anderson & Ewer, 2003: 346).

However, a study by Mumba, Rollnick and White (2002: 155) who investigated the 'gap' between school and first-year university Chemistry seems to contradict these studies. The results showed that there was no gap between the syllabi. However, the study showed that there were gaps between the school and university in terms of the level at which assessments were administered as well as in the teaching styles.

These studies all agree, with the exception of the Mumba, Rollnick and White (2002: 155) study, that students are not well prepared by the school system for tertiary studies.

2.2.2 Communication difficulties

Howie and Plomp (2002: 11) investigated the relationship between Mathematics achievement and students' proficiency in English at South African schools. The report on the study showed that students are likely to achieve higher scores in Mathematics when their language proficiency in English was higher and tended to achieve low scores in Mathematics when their scores in the English test were low. The study also revealed that children from homes where African languages were used were more likely to achieve low scores. Besides the language problems, the study claimed that factors such as socio-economic status, students' self-concept and the importance of Mathematics are also related to Mathematics achievement (Howie & Plomp, 2002: 12).

Barton, Chan, King, Neville-Barton and Sneddon (2005: 722 & 728) have investigated the issues surrounding the learning of Mathematics at the University of Auckland, New Zealand, by students who have English as an additional Language (EAL). The study was done in three parts, each with a different focus. The studies found that EAL students are disadvantaged by the language in the learning of Mathematics and that the students were

unaware of their disadvantage. These authors claim that the language disadvantage suffered by EAL students in Mathematics achievement in first-year was at least 10% (compared to English first language speakers). The third study indicated that the language disadvantage was greater at third year level because of increasing complexity of the subject and the discourse of the subject.

All these studies indicate that EAL students' learning are negatively affected by the medium of instruction. Institutions should take cognisance of this disadvantage and institute measures to support EAL students' learning.

2.2.3 Social integration

Wilcox, Winn and Fyvie-Gauld (2005: 720), in a United Kingdom study, argue that to understand higher education student retention, equal emphasis needs to be placed on social integration of students into the institution, and on academic issues. Making compatible friends at these institutions is essential to retention as are living arrangements. Their argument is that friends provide emotional support, particularly in times of stress, which is akin to that of family support. The article further advances that living at a student residence provides students with a greater chance to develop friends. Students living off-campus find it difficult to develop friendships because of the time and effort taken up with travelling.

Likewise, Pearce (2006: 1) in referring to University of Cape Town foundation engineering students, indicated that some students struggle to fit into the institution's environment. Some of them are in residences but are homesick, do not make friends easily, find it difficult to approach lecturers and do not work in groups. They consequently get stuck with problems and give up. When these students realise that they are struggling, it is often too late. Pearce (2006: 10) also claims that the families of these students do not understand the preparation required for university study and may not understand the need to assist them.

Social issues as indicated above, appear to play a big role in students' wellbeing. It is important for institutions to support or at least be aware of the negative impact issues of transport, residence and 'belonging' could have on students' studies.

2.3 Students' perceptions of their learning

2.3.1 Group work

van Rheede van Oudtshoorn and Hay (2004: 130) investigated students' perceptions of group work at the University of Pretoria. The study found that students were positively inclined towards group work. They indicated a preference for this mode of learning as opposed to individual learning. Students were also comfortable with the group dynamics. The study showed that students preferred an interactive atmosphere in the class to a passive form of learning.

2.3.2 Preparations for tertiary studies and career guidance

A study was done by Mji (2002: 175) amongst disadvantaged students at a university in the Eastern Cape (a province of South Africa) on their perceptions regarding their motives to study at university. The study revealed amongst other results; that obtaining university qualifications would enable them to get good jobs; that students perceived that they were well prepared for university education and that they did not receive career guidance when they were at high school. Lack of career guidance would most likely negatively influence a student's choice of study and students may decide to become engineers simply due to perceptions of obtaining good employment on finishing their studies.

2.3.3 Foundation programmes

Wood and Lithauer's (2005: 1002) study of former Nelson Mandela Metropolitan University's Foundation Programme (Eastern Cape Province) students' perceptions revealed that the foundation programme had a far-reaching effect on many aspects of the students' lives and not only on their academic performance. The participating students perceived that the academic, social and emotional skills they acquired were beneficial in

helping to prepare them for mainstream studies. Results from a longitudinal study show that students who complete a foundation year tend to perform better in later undergraduate/graduate studies than directly admitted students with similar academic profiles. The study recommended that the subject content of foundation programmes be carefully checked against the school curricula and the content of first year modules, in order to avoid repetition which might frustrate and bore the students. The issue of avoiding repetition that could lead to frustration and boredom is similar to that of using the extended time of the foundation programme in such a way that it does not have the opposite effect to the aims of the programme.

The issue of the positive effect of foundation programmes on its students is encouraging since this is supported by evidence of students' improved performances in the study. A study done at CPUT by Nsibande (2006: 11) on students' perception of foundation programmes also shows that students have positive perceptions of foundation programmes. However, available statistics, Garraway (2006), on students' performances on the foundation programmes do not show good performance gains.

2.4 Group work

The studies in this *Literature Review* use the term cooperative learning mainly, instead of group work since many of the studies were conducted in the USA. However, the term, group work will be used throughout the study as it is better known amongst the students who participated in the study. For the purposes of this study, I consider group work and the cooperative-base group type of cooperative learning used in the intervention described in section 1.4, *Intervention programme*, to be the same.

Cooperative learning can be described as the use of small group learning in which students work together to maximise their own and each others' learning (Smith, Johnson, & Johnson 1981; Johnson, Johnson, & Smith, 1991). I shall use this description of cooperative learning for group work.

Smith, Sheppard, Johnson and Johnson (2005: 93) distinguish between four types of cooperative learning models: informal cooperative learning, formal cooperative learning, cooperative base groups and problem-based learning. Cooperative base groups are long-term established groups of stable membership with the goal to provide each student with support, encouragement and assistance to make academic progress. This is the type of group work that the *Intervention programme*, section 1.4 is based on.

A cooperative learning Mathematics programme aimed at underrepresented minority groups at the University of Cincinnati, USA, to improve retention, academic success and graduation rates was considered a success (Moore, 2004: 9). The cooperative learning model used was a constructivist type of pedagogy. Students were encouraged to work in groups outside class as well. This cooperative model is different to the one used in the intervention programme at CPU. However, the pedagogy was also a form of group work which was intended to support student learning.

Extensive research that has been done on various forms of group work has shown gains in academic success, quality of relationships, psychological benefits, attitudes towards studies and promoting persistence at university level (Smith, Sheppard, Johnson & Johnson, 2005:91; Springer, Stanne, & Donovan 1999:21; Moore, 2004: 9).

On academic success these studies show that cooperative learning promotes higher individual achievement than competitive approaches or individual efforts. Even the best lectures achieve student achievement gains that are lower when compared with interactive engagement classes (Smith, Sheppard, Johnson & Johnson, 2005: 92).

Student participation, teacher encouragement and student-student interaction are also positively related to improved critical thinking (Smith, Sheppard, Johnson & Johnson, 2005:92, quoted from McKeachie et al. 1986).

Other benefits related to cooperative learning include improved self-esteem and better social skills. These are all based on American studies done at tertiary institutions. This

pedagogy is supported by the influential National Council of Teachers of Mathematics (NCTM) standards for teaching which calls for greater emphasis to be placed on student discourse and learning environments which include collaborative group work and student-teacher interaction (Moore, 2004: 2, quoted from NCTM 1991, 2000).

In my review of the literature, I managed to find only one study that was done on group work at a UT in South Africa. This study on cooperative learning (Potgieter & Webb, 2004: 33) has proved that, not only can improvement in results be achieved, but that the students experience non-cognitive gains such as interpersonal communication skills as well.

Brodie and Pournara (2005: 35) researched different forms of group work in South African schools in the context of the introduction of the post-Apartheid curriculum policy, Curriculum 2005, which encourages the use of group work in schools. They have identified that researchers and teachers view and use group work differently, which are dependent on their theoretical perspectives and assumptions.

CHAPTER 3: A THEORETICAL FRAMEWORK

The theoretical framework within which this study is located and which is used for viewing the data is the perspective on learning developed by CREE⁸ (Centre for Research in Engineering Education) (Allie et al., 2007) and was presented as a position paper. The CREE perspective will be referred to as the community perspective. The paper is described in section 3.4, *The CREE perspective (the community perspective)*, of this chapter. I have chosen to name this perspective, for the purposes of this study, as the student communities perspective. I am well aware that the CREE article refers to other communities besides student communities but the latter is of particular relevance in this study. The main reason for this choice of perspective was motivated by the fact that the data from the interviews to a large extent reflected learning within student communities. The learning within communities, as reflected in the data, supported aspects of their learning, such as, assistance with solving Mathematical problems and communication difficulties.

However, in order to understand my choice of perspective, it is first necessary to outline a number of perspectives on learning that are currently still used to understand student learning. These are a deep and surface approach to learning, alienation and engagement and the participation and acquisition perspective on which the student communities perspective is based.

3.1 Deep and Surface approaches to learning

The most common way in which educational researchers have described student learning in higher education is by the concepts of surface and deep approaches to learning. These

⁸ Centre for Research in Engineering Education (CREE) is a community of Engineering and Science educators from tertiary institutions, but based at UCT, which aims to improve education at higher education institutions by encouraging academics to engage in educational research.

approaches are outlined in this section as well as the complexities associated with each one.

An approach to learning describes the relation between the learner and the learning task (Ramsden, 1987: 276). The concept of approaches to learning has its origins in cognitive psychology as it focuses on the cognitive aspect of the learning experience (Case, 2008: 2). The surface approach describes learning mainly by means of rote memorisation of facts. However, a surface approach to learning can lead to successful learning in terms of results (Haggis, 2003:93). There are cases where memorisation, usually associated with rote learning, leads to understanding which is generally considered to be associated with a deep approach.

A deep approach to learning, on the other hand, refers to a focus on the task to derive meaning from it and to focus holistically on the task (Ramsden, 1987: 276). A deep approach to learning and 'ways of understanding' which include more ways of conceiving something, are 'more likely' to result in high quality learning outcomes (Haggis, 2003:93, quoted from Prosser & Trigwell, 1999: 4).

Getting students to adopt a deep approach to learning is not easy. Research with regard to encouraging students to using deep approaches to learning has delivered contradictory results. Some research into the effectiveness of 'inducing' deep approaches to learning has shown the opposite effect of creating an increase in surface approaches (Haggis, 2003: 93, quoted from Marton & Säljö, [1984] 1997). It is quite ironic that higher education institutions overtly value and encourage a deep learning approach, yet the institution can by its teaching and assessment procedures actually be aiding and even creating surface learning approaches (Haggis, 2003:92, quoted from Norton & Crowley, 1995).

The approaches to learning perspective is not appropriate for this study since it is very limiting in that it focuses only on the cognitive aspect of the learning experience. Malcolm and Zukas (2001: 38) contend that this perspective of learning does not take

sufficient account of the learner's social and cultural context. This perspective has been inappropriately used; for example, students have been labelled deep learners which is contrary to the understanding of an approach to learning which is not fixed but dynamic (Ramsden, 1987).

3.2 Alienation and Engagement

Mann (2001) and Case (2008) offer an alternative perspective to describe student learning experiences; from a focus on approaches to learning to a focus on alienated and engaged experiences of learning. Alienation enables one to describe students' learning experiences at higher education institutions in terms of the way that students are negatively affected and left with feelings of powerlessness by the way that curriculum and teaching and learning issues are instituted at these institutions. The response required from educators should be an awareness of their own 'positional power' and the power relations within the teaching and learning and educational process (Mann, 2001: 17).

The response that educators could offer students to counter the effects of alienation are: solidarity with students, to be more hospitable towards them, to offer them safety in terms of being accepted and respected, to examine practices that hinder students' own control of their learning processes and being critical (Mann, 2001: 17).

Although the concept of alienation offers one a useful perspective to characterise Black South African students' experiences in higher education, the solution offered by Mann and Case, a perspective on learning of engagement, has not been explored sufficiently. In both articles by Mann and Case the focus is on alienation and very little is said about the alternative perspective of engagement. The perspective of engagement appears to be close to the participation perspective which will be discussed in the following section.

3.3 A view of learning as participation instead of acquisition

Sfard (1998: 4) argues in favour of a view on learning that favours participation instead of acquisition.

According to Sfard (1998) the acquisition view on learning focuses on the transmission or the gaining of knowledge. The view of acquisition includes individual and social constructivism as well as interactionism, since the focus is on the acquisition of knowledge. The emphasis in the acquisition perspective is on personal gain and which is the most commonly held perspective on learning, including that of most of the well known scholars in education (Sfard, 1998: 5).

In contrast to the focus being, in most of the views on learning, on acquisition, some literature refers to learning as 'learning in a community', 'a legitimate peripheral participation' and 'learning as an apprenticeship in thinking' (Sfard, 1998: 6, quoted from Lave & Wenger, 1991; Rogoff, 1990). The focus is on being part of a learning activity. However, this focus on participation does not imply a rejection of the acquisition aspect of learning but places the emphasis on shared activities and communication.

Acquisition and participation is not a case of individual and social distinction, as the participation aspect of learning is present in some acquisition perspectives (Sfard, 1998: 7). The distinction between the acquisition and participation view is that the emphasis in the acquisition view is on the personal acquisition of knowledge, while the participation view focuses on participation in a community. A comparison between the acquisition and participation views of learning is given in Table 1, on the next page.

Sfard, when referring to the participation view on learning, does not refer to the use of a specific teaching methodology. However, since the focus is on being a participant in activities and in communities, group work could be considered to be a useful form of participation if conducted in such a way that it allows participation in a community.

The view on learning by Sfard offers a more appropriate perspective on learning to view the data for the study than does the perspective, deep and surface approaches, and a more developed perspective than alienation and engagement, previously discussed in this chapter.

A comparative representation of acquisition and participation is presented in Table 1 (Sfard, 1998: 7).

Comparison		
Acquisition		Participation
Individual enrichment	Goal of learning	Community building
Acquisition of something	Learning	Becoming a participant
Recipient	Student	Peripheral participant
Provider, facilitator	Teacher	Expert participant
Possession (individual, public)	Knowledge, concept	Activity/ discourse
Having, possessing	Knowing	Belonging, participating, communicating

Table 1: Comparison between Acquisition and Participation views of learning (Sfard, 1998: 7)

3.4 The CREE perspective (the community perspective)

At the initial stages of the study, a theoretical framework had not been identified yet. The study advanced during the time that CREE had been engaged in workshops with interested parties to arrive at a response to issues affecting throughput rates in science and engineering at higher education institutions. I was also a participant in these workshops. These workshops culminated in the writing of a position paper by twenty one authors from CPUT, the University of Cape Town (UCT) and the University of the Western Cape, which I will reference as Allie et al. (2007) in this discussion. As my study proceeded it became clear to me that the evolving CREE response, which focussed on participation in a community, provided the most useful account of the data in my study.

This perspective on student learning, which I have chosen to call the community perspective for the purpose of this study, is based on that of Sfard (1998) which was discussed above, but adapted for the particular context in which I work. This position paper is currently being developed further and I consider this study as contributing towards it. In the discussion of the community perspective below, I reference the current published version of the CREE position paper (Allie et al., 2007).

The community perspective was developed in response to the low throughput rates in science and engineering at tertiary institutions in South Africa as well as to the need for more science and engineering graduates in the country. It calls for research into student learning in order to respond to the issues affecting student learning as well as to develop a deeper understanding of the education system in order to improve student learning (Allie et al., 2007: 2).

According to the community perspective, learning in a community means taking on the discourse of that community, where discourse refers to using spoken and written language as well as using the appropriate actions, tools, sign systems, behaviours, etc. of the community. For example, discourse in engineering refers to using data, symbols, equations, calculations and the like that characterises one's membership of the community of engineers (Allie et al., 2007: 2). Furthermore, participating in the discourse of a community also involves adopting a certain identity. Taking on an identity depends on the particular situation and the discourse of that community, which in the position paper is termed a discursive identity.

The community perspective recognises that students will inhabit different communities, and hence calls for the recognition of the multiple identities students have, which include being a student, an engineer in training, a cultural identity as well as for the need to provide authentic identities in the fields of their study. They may also have other identities besides those mentioned. The community perspective argues that success and failure in higher education can be explained in terms of engaging with the appropriate discourses and adopting the particular identities.

Three parts of the community perspective (CREE) are of particular relevance in the study:

1. As lecturers we need to develop an understanding of the communities from which students come to study at tertiary institutions. We may thereby create appropriate and supportive teaching and learning environments at our institutions.
2. There is a need to develop a conception of what the “classroom community” should look like in the Mathematics classroom, and in my case in the Mathematics classroom for prospective engineers. The community perspective sees learning as participation in communities. In the context of tertiary engineering this involves students participating in classroom communities that will prepare them for the workplace communities that students will enter upon finishing their formal studies.
3. There is also a need to develop an understanding of student communities outside of the Mathematics classrooms at CPUT. The community perspective, like that of the participation perspective of Sfard (1998) suggests that learning is a case of ongoing involvement. However, the community perspective does not make reference to student communities outside the classroom, which this study considers important. Student communities should be developed in classrooms, student residences, and elsewhere as it could provide opportunities to support student learning.

Although I consider the community perspective in its entirety to be important for student learning and for framing the perspective in this study, I have decided to focus on an aspect of the community perspective of learning, which I will refer to as student communities since such a perspective suits the data for the study.

The group work intervention programme that I implemented in the foundation class at CPUT, in which the study was undertaken, supports this view of understanding learning as participation in student communities. The aim of the intervention was to support student learning by creating student communities in the form of getting students to work in groups in the Mathematics class. Students were also encouraged to work together in other subjects and outside of the classroom. The focus on group work should be on

assisting each other in all aspects relating to improving each others' understanding of the subject, in this case Mathematics. This would include assistance with the medium of instruction, English, which is not the students' home-language.

In this chapter I have presented different ways of viewing student learning in higher education. I have chosen to use the student communities perspective, based on the community perspective (Allie et al., 2007), because it emphasises becoming part of a learning community which is appropriate for viewing the data for this study.

University of Cape Town

CHAPTER 4: RESEARCH METHODOLOGY

4.1 Introduction

Research in education takes the form of being either quantitative or qualitative. A criticism of traditional quantitative research is that it is essentially about ‘how individuals act in narrowly defined and inherently artificial contexts’ when research settings are controlled or manipulated, which is often the case in traditional research (Hatch, 2002: 7). In qualitative research, on the other hand, the focus is on understanding the experiences of people in real settings. The purpose of the study is to understand students’ perspectives on the issues that influence their learning in Mathematics at CPUT, with a particular focus on group work.

This chapter starts by describing the paradigm in which the research is conducted. An understanding of the particular paradigm is essential for one to understand how the study was designed and undertaken. The data collection process for the study is described, which was done by means of qualitative interviewing, including the selection of students for the interviews, as well as the interviews. The procedure for analysing the data is described as well. The last two sections of this chapter deal with the issues of the research quality and the ethics for the study.

4.2 Research Paradigm

In my opinion as researcher, a constructivist paradigm for educational research would be an appropriate perspective to adopt in order to do the research interviews in this study. Hatch (2002: 15) advances the ontological and epistemological view that constructivism assumes the world as having multiple realities and the focus of attention is that of the individual perspective of reality. Each individual experiences the world differently and thus the researcher has to understand and report the individual’s experiences within the particular context.

Assuming a constructivist paradigm implies that it is important to acknowledge my own position within the setting of the research, as I have done in Section 1.2, *The researcher*, my own perspective of reality will influence the study. Furthermore, there will be implications for issues of the quality of this research study. For if there are multiple realities, we can ask, are all realities equally valid? Issues of quality are dealt with in detail in section 4.6, *Issues of quality*, of this chapter.

4.3 Qualitative interviewing as a means of understanding student learning

Interview research is common to both quantitative and qualitative studies. In quantitative studies the interview questions are usually of the type which requires limited choice of answers and which are then analysed using statistical procedures (Hatch, 2002:23). In contrast, qualitative researchers use interview strategies that require the type of questions which are open-ended and which prompt participants to speak freely about the way they understand a particular situation which may be completely different to that of another person. The interviewer/researcher listens with the aim of understanding the meaning that the interviewee attaches to a particular situation. Making meaning from participants' lived experiences is imperative in qualitative interviewing. The interviewer does not have a fixed set of questions in an interview situation, but generates questions during the interview in response to the interviewee's responses (Hatch, 2002:23).

Kvale (1996: 5) makes reference to the miner and the traveller metaphor to describe ways of conducting interviews. Instead of delving for information, as the miner does, the traveller, through conversation, allows the interviewees to tell their stories the way they lived. Conversation is here understood to mean a process whereby the parties, in other words, the interviewer and interviewee, arrive at new understandings which in turn may result in them even being changed by the process. In contrast to conversation, a discussion between two people is a process whereby each party tries to convince the other of the strength of their respective views they have. In a conversation, the parties seek to

understand the other's view in terms of the way that the individual sees it and tries not to persuade the other person of any different view that he or she may hold.

In my interviews I have attempted to use the traveller metaphor instead of that of the miner. In the case of student learning, new understandings are important for me, the lecturer/researcher. The goal of the research is to understand student learning better so that as a lecturer, I may then implement teaching and learning strategies that could assist student learning. The interview, in the form of a conversation, seeks to understand the perspective of the student being interviewed without putting my own viewpoint across. This can be of great benefit to both the student and myself, lecturer/researcher.

4.4 Data Collection

The method used for the investigation into student perspectives of their learning was through interviewing. A selection of students from a first year Civil Engineering Mathematics class at CPUT was interviewed. The particular class of thirty five students was on an extended curriculum programme because they did not meet the institution's minimum entry requirements to study Civil Engineering.

4.4.1 Selecting students

The class from which the students were selected for the study consisted of Black, Coloured and White students who originate from various parts of South Africa. The students were selected by means of a questionnaire (See Appendix1). The questions enquired about the students' home-language, the students' home (primary) address and the high school the students attended. Although I had Black students in mind for the study, I requested the entire class to fill in the questionnaire. The information received from the questionnaire was sufficient to select eight suitable students from the class. Since this is a qualitative study, the number of students participating in the study was small (Adler, 2001: 37).

The Black student population makes up the largest percentage of students at these institutions, as well as at CPUT and the highest failure rates also occurs in this segment of the population (Scott, 2006). It was primarily for this reason that the study focussed on Black students at CPUT.

My second criterion was to select students who attended historically Black schools (township schools). Due to the Apartheid policies of the past, schools were segregated along racial lines. Since the abolition of Apartheid in 1994, there has been an increase in the numbers of Black students attending schools in Coloured and White areas. However, the overwhelming majority of Black students still attend schools located in the working class, Black townships. During the interview process, I discovered that one of the students was schooled at an ex-model C (previously Whites-only) school. I initially did not plan to include such a participant in the study. However, I thought that having an ex-model C student as a participant, might provide interesting information and could be used to compare this student's perception of learning with the rest of the selected group.

My third criterion was to select students whose English communication skills would enable a reasonable conversation. I deliberately avoided students whose English communication skills, in my opinion, were such that it would make understanding or making meaning from an interview difficult. Some students were also ignored from possible selection due to their regular absence from class.

A fourth and last criterion was to select from some groups two students per group. The reason for this criterion was to get more than one student's perspectives of the workings of their groups. I selected two students each from three groups and two individuals from other groups.

No consideration was given to the economic circumstances, gender and geographical origins of the students. One of the selected students was a female. She was one of only two Black female students in the class. Of the eight selected students, six were from the Eastern Cape Province of South Africa and two were from the Western Cape Province,

the province in which the study was located. A large number of Eastern Cape Black students attend schools and tertiary institutions in the Western Cape. This is reflected in the particular class in which Eastern Cape Black students were well represented. The eight students represented the range of abilities in Mathematics amongst the Black students in the class, based on their marks for the Mathematics course.

The students that were selected for the study all had Xhosa as their home-language. Although I had already excluded some students on the basis of their poor communication skills from possible selection, the English communication skills of those students who were selected still had implications for the study, as discussed in the section below.

4.4.2 The Interviews

Each student was interviewed once according to the set of interview questions in Appendix 2. The interviews started towards the end of July and were completed within two weeks. The interviews took place in my office. This environment was the most convenient place for me since it was free from disturbances (recording the interviews and the set-up was more conducive to a conversation than elsewhere, like a classroom). This was most likely not the ideal place from the student's point of view as it placed me in an advantageous position in terms of the criteria of what should constitute a conversation. However, no other place on the campus may have been more conducive to a conversation than my office. Most of the interviews took place during the official lunch breaks on campus or at times when a particular student did not have to attend class.

Students might have spoken in favour of what I had promoted in class, such as group work, because of power issues. Because I implemented the group work intervention, they might have felt that it would be in their interest to speak positively about it. My position of authority as their lecturer and marker of their scripts could have had a negative psychological influence on their responses during interviews. These were some of the issues that I had to take into account in planning the interviews and in the interview situation itself. In this regard I explained the purpose of the research to the students, both at the point at which I asked for their participation in the study and at the start of the

interview itself. I made it clear to them that their honesty would benefit the research and that they needed to state their views even if they were contrary to what I would value.

Issues such as leading questions and my role as researcher and lecturer were not always easy to negotiate, but at least being aware of these issues helped me to deal with them much better and my ability to do this improved with experience. Since the interviews took place in English, which is not the students' home-language, it was often necessary to rephrase a question to help students to understand the question. Since leading questions would nullify the value of the students' responses, I did my best to avoid such questions.

Besides the issues of leading questions and students' communication difficulties, time management also presented a problem in the first interview. The first interview with Thembi took about fifty minutes and would have gone on for a longer period had the student not expressed the need to leave in order to catch a train. I thus could not finish the entire list of questions that I had planned to ask. Afterwards, I reflected on how the interview transpired and with the upcoming second interview in mind, I realised that I had spent too much time on certain questions. Consequently I decided to devote about thirty minutes per interview thereafter. This, I discovered, was sufficient time, to explore all the questions with the participating students.

The detail with which students responded to questions varied. Some spoke freely about their experiences, often dealing with issues that I would have wanted to bring up at a later stage of the interview, while others answered questions with minimum detail.

4.4.3 Transcriptions

In the transcripts and elsewhere in the study, pseudonyms were used instead of the students' real names (see section 4.7, *Ethics*). All the interviews were transcribed by the researcher and used as data for the study. Setati (2003: 294) argues that transcriptions are 're-presentations' of the data in a different form. Without a sufficient account of the re-presentation of the data, the claims that we make about teaching and learning will only be weakened (Setati, 2003: 294). Also re-presentation of data occurs from interview to

transcription and from transcription to interpretation. Setati (2003: 294) argues further that re-presentation of data raises concerns about the quality of the research. The quality of research deals with the issue of the trustworthiness of the study. I thus took steps to ensure that the transcription process was done with care so as to ensure this aspect of the quality of the research. Issues on quality of the research will be discussed in more detail in section 4.6, *Issues on quality*.

For the interviews, I decided to transcribe each and every word uttered by the students that relates to the study. However, it would be pointless to transcribe something that has no bearing on the subject. Also, subconsciously one may be influenced by one's own worldview when transcribing the data and thus may not value something said by the interviewee that he/she considers to be important. One may deduce that this makes the process selective. Setati (2003: 294) argues that re-presentation of data is a selective process and thus the challenge is to generate a transcript that best represents the recorded interactions. It is essential that the researcher and transcriber be guided by research ethics and by the way conversation had been defined earlier in this chapter, to ensure that the interviewee's representation of events was recorded accurately. Awareness and reflection on the transcription process are thus vital. Transcribing data is thus 'not just talk written down', but also a re-presentation of the interview in which data is constructed for a particular purpose (Setati, 2003: 295).

In this study, it has proved to be beneficial to have been the interviewer as well as the transcriber, since some of the recorded material was not always clear. Since I did the transcription on the same day as the interview, I was able to make better sense of the conversations on the tapes as opposed to someone else doing the transcriptions. Also, if the transcriptions had been done at a later stage, I might not have remembered as much of the interview. At times during an interview with Thando, he had his hand in front of his mouth, which resulted in parts of the interview on the tape being unclear. However, because I did the transcription on the same day the interview took place, I was able to make sense of incidents such as that of Thando.

Another benefit to have done the transcriptions myself was that it immersed me in the data and enabled me to get to know it well.

The conventions that were used in the transcriptions are illustrated by means of the following example:

- 19 I: Did you always understand him?
20 Bongi: Not always, but I had my friend.

The numbers in front of the quotation indicate the line position in the transcript for that student interviewed. “I” designates the interviewer and “Bongi” the particular student. The round brackets are used in the transcripts to indicate an action or comment that was implied, but not expressed. At times when the tape recording was not clear, I indicated what I could make out from the conversation in round brackets or by using the word “not clear”.

In presenting text from the transcript in writing up the analysis in chapter 5, I have indicated the line numbers in the square brackets at the end of the quotation. An example of a quotation in the analysis is shown below:

- Simphiwe: Yes she ...when we do not understand...then (the teacher) use
 Xhosa so that we can understand more [41].

4.5 Analysing the data

Hatch (2002: 148) advances the point that data analysis ‘is a systematic search for meaning’. The process of analysing qualitative data enables one to report what has been learnt. The analysis process includes organising and interrogating data such that the researcher can ‘see patterns, identify themes, discover relationships, develop explanations, make interpretations, mount critiques, ...’ and ‘It often involves synthesis, evaluation, interpretation, categorisation, hypothesising, and pattern finding’ (Hatch, 2002: 148). Many of these processes were used in the analysis of the data in this study.

The analyses process occurred by means of several cycles of interrogation of the data to arrive at themes that best represent the stories of the interviewees. The focus of the study was initially group work. However, by the time that I did the analysis, I realised that I had to broaden the scope and the focus of the research to student learning and the factors that influenced it. In the process of interrogating the data, I tried to find themes that best represent the aims of the research as well as the accounts of the interviewees. I used mind-maps on which I indicated the themes and the respective codes that I could link with each. In the end the mind-map, with its related codes and sub-codes that in my opinion best represented the aims of the research and the students' views, was the one that was used to further the analysis.

The five themes that were identified from the interviews relate to students' perceptions of:

1. the similarities and differences with respect to the teaching and learning practices at students' old high schools compared to that at CPUT;
2. the factors influencing students' learning;
3. students' positive and negative experiences of group work;
4. what group work means to the students, and
5. different forms of group work that students may have been engaged with at school.

Each of these themes was then subcategorised into its different dimensions or codes. In some cases it was necessary to further subcategorise these codes so that each code or subcategorised code represented an assertion which should in turn be supported by actual evidence or quotes from the transcriptions

I present the full list of themes, codes and sub-codes below after which I provide an example of the process of how codes were subcategorised and written into an assertion with its supporting evidence.

<u>Themes</u>	Codes	Sub-codes
Students perceptions of:		
1. Similarities and differences with respect to teaching and learning at school and at CPUT.	1.Communication practices	1.(a) Between the teacher and the students 1.(b) Communication amongst students
	2. Teaching and learning practices	2.(a) The teaching practices employed by the teacher 2.(b) The learning practices of students
	3. Standards	
2. Factors that influence their learning	1. Medium of Instruction 2. Some issues relating to the teaching and learning of Mathematics at high school 3. Transport and residence problems 4. Developing friendships and adjusting to CPUT 5. Willingness and Motivation to seek help	
3. Positive and negative experiences of group work	1. Students assisting each other	1.(a) Weak students receiving assistance
		1.(b) Explanations that were more detailed
		1.(c) Mistakes picked up by peers
		1.(d) Shorter methods which were shared
		1.(e) Receiving immediate help

		1.(f) Assistance in the home language of the student
	2. Improved Mathematics performance	
	3. Dependence	
	4. Group Dynamics	
	5. Interruptions	5.(a) Digression from topic
		5.(b) Having to assist others
4. What group work means	1. A natural process 2. Working in the classroom and outside 3. Receiving assistance, giving assistance or sharing	
5. Different forms of group work	1. Teacher-initiated group work (formal) 2. Teacher-initiated group work (informal) 3. Student-initiated group work	

Table 2: Analysis of the five themes that were identified from the data

For example, in theme 3, sub-code 1(a)

“weak students receiving assistance”, was represented by the assertion:

“A student indicated that a peer who was struggling with Mathematics received the kind of help in the group that benefited him.”

This assertion was then supported by actual quotations from the transcriptions as supporting evidence for the assertion.

Andile: Yea, because some of us in our group...Mfundo...he was struggling with Maths then we were trying to help him, and then we help him [94].

There were cases where I used a quotation for more than one assertion. The following quotation supports more than one assertion (my emphasis in bold):

Simphiwe: For now...yeah...I get help quickly and **I passed because of that**. Because when there's wrong ...something that I don't understand. When you're working alone you can't even see you're making a mistake, but when you're working in groups then someone will tell you ...no, **you made some mistake here** [84].

The quotation refers to “I passed because of that” and “you made some mistake here”, which supports the following two assertions:

- (a) Some students claimed that the support they received by working in groups resulted in improved performances in Mathematics {code 2 of theme 3}.
- (b) A student pointed out that by working together in a group, the students usually picked up each other’s mistakes {sub-code 1(c) of theme 3}.

In some cases the codes of different themes overlapped. An example of this overlapping is the code, “Communication Practices” which appears in the first and in the second theme as “Medium of Instruction”. The code, “Communication Practices” focuses on communication practices between teacher/lecturer and students, amongst students in class as well as outside the classroom. The code “Medium of Instruction” focuses on the issue of learning in a language other than the home-language. The emphasis of the code in each of these themes is thus different and is thus not a repetition.

4.6 Issues of quality

Quantitative as well as some qualitative researchers make use of the term validity to answer questions regarding the legitimacy of the research. However, validity has often been associated with positivist assumptions that support quantitative research (Maxwell, 1992). In this regard it may be better to refer to the quality of the research. The quality of the research is associated with the issue of trust (Lincoln & Guba, 1985: 290). How can one convince the reader that the research path is important/beneficial, that it is good research and that it is specific to the Mathematics classroom (Adler & Lerman, 2003)? In this regard Lincoln and Guba (1985: 290) make reference to the trustworthiness of the research to indicate to the reader that the research is ‘worth taking account of’. To demonstrate trustworthiness one has to show that the ‘reconstructions’ that have been made through the study are ‘credible’ to the interviewees’ unique understandings (Lincoln & Guba, 1985: 290). The steps that Lincoln and Guba advocate are to undertake the study in such a way that the chances that the findings would be found to be credible

would be enhanced. This would include having the findings approved by the interviewees.

In the case of the present study, the students were interviewed and every attempt was made by me as the researcher to ascertain the experiences and opinions of these students the way it was known to them. The researcher and the participant construct a common account during the interview (Hatch, 2002: 15). The focus is on the meanings of the interviewees' stories. However, such an account is subjective as it reflects the happenings of a particular person's view of the world which of necessity involves interpretation. It is not possible that an objective account can be made of a person's experiences since most researchers are bound to interpret experiences in their own way and hence may not necessarily agree in their findings.

In this section I list the steps I took to ensure the "trustworthiness" of the account presented in this research.

- (a) Clarifying during interviewing: When a situation arises during an interview where the interviewer is unsure of the meaning, he/she should ask the interviewee to clarify what he/she may have said. An example of such a situation is the exchange discussed below.

During an interview with Bongi, I needed to investigate whether the teacher initiated the group work in the classroom or whether the students themselves initiated the group work. He did not respond adequately to the question. It was thus necessary to ask questions for clarification purposes. The following quotation illustrates the need to clarify any possible misunderstandings:

I: Did you put yourselves in groups?

Bongi: I was sitting in a group with my friends.

I: In a group of four?

Bongi: Yeah, in a group of four.

I: But your teacher did not tell you to sit in groups?

Bongi: Like, he ...the way the class was arranged ...was arranged such that people must sit in groups.

I: Ok, similar to the way that we have it here. So, the desks were put like that?

Bongi: Yeah [25 – 32].

- (b) Transcriptions: The quality of the research will also depend on the transcription process. As was discussed in section 4.4.3, *Transcriptions*, care was taken to ensure that the transcriptions took account of the meanings conveyed by the participants and that the transcriptions were fair representations of the students' views. The transcriptions were done word for word, so that little could get lost from the participants' views or meanings. This was undertaken by replaying the tapes to hear the wording as well as understand the meaning clearly. Since transcribing is a process of re-presentation of data, it is inevitable that some of the data will be lost in the process (Setati, 2003: 294).
- (c) Cycles of interrogation: The analysis process, as discussed in section 4.5, *Analysing the data*, occurred by means of several cycles of interrogation of the data to arrive at themes that best represented the stories of the interviewees as well as the aims of the research.
- (d) "Thick narrative": The assertions, descriptions of the particular evidence, quotations, commentary and counter evidence were written in the form of a "thick narrative" (Gallagher & Tobin, 1991) in presentation of the analysis in chapter 5. An attempt was made to provide sufficient quotations from the interviews.
- (e) Critical feedback: This was obtained from the supervisors of this research.
- (f) Ethics: The quality of the research, in general, should be guided by an institutional research ethics guide, such as the Guide to Research Ethics that can be found in the Faculty of Humanities, University of Cape Town. Section 4.7, *Ethics*, lists the steps taken to ensure the ethical needs of this research.

4.7 Ethics

This section deals with the efforts of the researcher to show that the interviewees have been accorded the respect and privacy for their willingness to participate in the research. At the time when the study took place, I (the researcher) was the Mathematics lecturer of the particular class. The entire class was verbally informed of the following before the questionnaire was administered:

- (a) The purpose of the study and what their participation in the study would entail;
- (b) The aim of the study was to understand how students were learning Mathematics and in particular how the learning of the subject occurred in groups;
- (c) Their participation in the study would be entirely optional;

The eight students, selected to participate in the study, were also verbally informed of the following:

- (d) They had the right to withdraw from participation in the study at any point;
- (e) The purpose of the interviews both at the point when their participation in the interview was requested and at the start of the interviews;
- (f) The aim of the interviews were to understand how the teaching and learning of Mathematics took place at their old high school and at the institution (CPUT) where they were studying at the time at which the study took place, and in particular as to how it affected their learning;
- (g) The data from the questionnaires and interviews would remain in my possession; no one else would have access to it and that pseudonyms would be used in the study;
- (h) The study formed part of a Masters Degree in Education for which I was registered at the University of Cape Town, and
- (i) There is also the possibility that the study may appear in a publication.

I was aware that, because I was the participants' lecturer, they might have felt obligated to participate in the study. However, I made them aware that they had no reason to feel any obligation towards me, that should they have declined to participate in the study, that as their lecturer, I would not have felt any differently about them. On the other hand,

those who had decided to participate in the study would not have been rewarded for their participation. Those students that agreed to participate in the study were asked to confirm their consent in writing.

All the students that participated in the study were over the age of eighteen years at the time at which the data collection occurred. Thus, it was not necessary to obtain parental consent. There were no reasons why any of the actual names of students had to appear in the study. I made use of pseudonyms. Students were informed of the confidentiality of the interviews and the anonymity of their names. Since only a few students were involved in the study, it was possible that, even though the actual names of the students did not appear in the study, the participating students would be recognisable to one another and to their peers in the class. I was sensitive to such concerns when I wrote up the research. The questionnaires, cassettes of the interviews, transcriptions of the interviews and the analyses thereof would remain in my possession and no one else would have access to them. If I were required or asked to have them viewed by anyone, I would make sure that the identities of the participants in the study would remain anonymous to those to whom it would be made available. I intend to destroy the data when the study has been completed and when I am sure that there would be no further use for the data.

Since the research participants were my students there were power issues at work. This situation should be seen in the context of the focus of the study, which is student learning. The participants in the study and I as their lecturer/researcher may intentionally or unintentionally react to what might have transpired in an interview that I had with them. The participants may also be receiving more attention, inadvertently, in the class as a result of my (researcher/lecturer's) awareness of them. This I, as researcher/lecturer have to keep in mind.

The faculty at the institution (CPUT) where the research was carried out did not have a code of ethics for doing research involving human subjects at the time when the study took place. The Head of Department of Civil Engineering was aware that I was conducting the study using students in the department.

CHAPTER 5: ANALYSIS

This chapter reports on the analysis of the interviews done with the eight selected students. In accordance with the five themes outlined in Table 2, page 38, the analysis began with the identification of different themes from the data. A full description on how the data was analysed, the five themes arrived at, how each theme was subcategorised into codes to form assertions, as well as how the analysis is to be presented was discussed in chapter 4, section 4.5 *Analysing the data*.

Since this is a qualitative study, an appropriate format to write-up the analysis is of the form: assertion, followed by (1) supporting evidence and (2) counter evidence (if any) (Gallagher & Tobin, 1991: 83 - 96). Gallagher and Tobin recommend that the interpretation should follow as a third step, however, for the study I have chosen to present the interpretation and literature support in chapter 6, *Discussion*.

5.1 Theme 1: the similarities and differences with respect to the teaching and learning practices at students' old high school compared to that at CPUT

The analysis revealed that some of the teaching and learning practices at CPUT compared to that of the students' high schools were similar and others again were different.

5.1.1 Communication practices

5.1.1.1 Between the teacher and the students

At students' high schools: The students indicated that their teachers switched from the medium of instruction, English, to the students' home-language, Xhosa, when the English

explanation was not understood (This practice I have called code-switching). Home-language is defined here as the language spoken at home.

Some students said that they received instruction in English most of the time. However, when it came to aspects which the students did not understand, the teacher resorted to the Xhosa. The use of code-switching is evidenced in the following quotation:

Thando: We were taught in English most of the time...70% of the time it was English. But when it came to specifics; when someone wanted an explanation, then the teacher would talk in Xhosa. But the teacher tried everything. Most of the time he said he should prepare us for tertiary education, so most of the time it was English [12].

The one student that attended an ex-model C school, Siphon, was taught in English only. This is clear from the following interview quote:

Siphon: It was not very different from your type. He was also speaking English... [8].

In the case where the teacher did not speak the language of his students, the student often relied on the assistance of other students, in particular where students sat in groups. The following comment relates to Bongini whose teacher used only English in class:

I: Did you always understand him?
Bongini: Not always, but I had my friend. He was...understand quickly. So, he used to explain things to me...[19 – 20].

This explanation occurred in Xhosa, which is clear from the following quotation in which Bongini refers to the language spoken in his group:

Bongini: We speak Xhosa [102].

Therefore, in the case where the teacher could speak Xhosa, the teacher used mainly English to prepare students for tertiary studies where the medium of instruction would be English only. Thus code-switching was used only when the English explanation was not

sufficient for the student to understand what was taught. All the students, in this case, indicated that code-switching occurred. In the case of the ex-model C student; he most likely did not have a similar form of assistance in class except to ask the teacher to repeat him/herself in English. This student also indicated that no form of group work was used in his class. Group work is discussed in section 5.5 of this chapter, *Different forms of group work*.

At CPUT: Communication between the lecturer and the students happens in English only. The problems experienced by students as a result of being taught in the medium of English, are discussed in the section below.

5.1.1.2 Communication amongst students in the classroom

At student's high school: No direct question was asked about the language of communication that students used amongst themselves in the Mathematics class at high school. However, since all the students, except one, spoke Xhosa in their group at CPUT, it is likely that they also spoke Xhosa at school amongst themselves. This clear in the following quotation:

Bongi: We speak Xhosa [102].

At CPUT: Seven out of the eight students indicated that communication amongst students in their groups in the Mathematics class took place in Xhosa only. It is the language that they use socially amongst themselves. They explained to each other in Xhosa when some of them did not understand the lesson or an aspect of it. This is evident from the following quotation:

Xolani: We speak Xhosa, sir,...because...we all use the same language [96]; and

Sipho: I usually ask the teacher, but with the group thing its also good...because if you don't understand that...maybe you did not grasp it...because it was maybe English the peers that you're sitting with can also tell you in your own language and you...understand better [60].

Sipho had attended an ex-model C school at primary and high school level. It is significant that he indicated that code-switching benefited him at the UT.

5.1.2 Teaching and learning practices

5.1.2.1 The teaching practices employed by the teacher

At students' high schools: The students indicated that their high school teachers taught in the following way: the teacher taught a section of work, including some exercises, which was followed by a set of exercises that the students had to do in class (I have labelled this earlier as a traditional teaching methodology).

From the comments of all eight students it can be deduced that all their teachers made use of a traditional Mathematics teaching methodology. For example in the following comment Vusi states that the teacher started a chapter, did exercises on the board which were followed by exercises done by the students:

Vusi: Okay, firstly, he introduces a chapter and then do some exercises there and then after that he let us do our own exercises [60].

At CPUT: The teaching of Mathematics occurred in a similar way to that at the students' high schools. The following quotations support this assertion:

Sipho: It was not very different from your type. He was also speaking English. He wrote on the board [8]; and
Yeah, he used to explain stuff on the board and then he gives us homework and then the next day we tell him our problems...[12].

No direct question was asked about how teaching took place at CPUT. However, students were asked to compare their experiences of their schools with that at CPUT, in which students would refer to the teaching practices in the Mathematics classroom at CPUT.

The teaching and learning practices relating to group work are discussed in section 5.5, *Different forms of group work*.

5.1.2.2 The learning practices of students (with a focus on test preparation)

At students' high schools: Students indicated that in preparation for tests, they worked through examples that were previously done in class by their teachers.

Sipho said that he read through the work done by the teacher in class. He worked out some of the problems and compared his answers with that of the teacher's to check if his answers were correct. This assertion is evidenced by the following interchange between the interviewer and the student:

- Sipho: When I'm learning for a test I go through...I go through all the stuff that you've done before and see if I know them.
- I: Do you just look through them or...
- Sipho: I do the problem and then I see if the answer is the same.
- I: And that's the same way that you learnt at high school?
- Sipho: Yes [53 – 56].

This manner of preparing for a test was common amongst most of the interviewees.

At CPUT: The students said that they followed the same procedure when preparing for tests as they used at school: Bongi said that he read through what was done in class and repeated problems that were already done. This is evidenced by the following quotation:

- I: Here at CPUT?
- Bongi: Yeah, when I get to the residence, I follow what I did in class...just try it...just try it what I can do...[119 -120].

Not all the students were asked directly about the way they prepared for tests at school and at CPUT. Some students may have indicated in the context of describing their experiences at the UT, how they prepared for a test. It is possible that students did not change the way they learnt Mathematics after joining CPUT. The nature of the Mathematics syllabus at CPUT does not really require a changed approach.

5.1.3 Standards

A student mentioned in an interview that the pass requirements at CPUT were different to that of his high school.

As noted in section 1.3.2, *Focus on the students*, at CPUT the pass requirement is 50% in all the subjects. What is also different is that there is only a single level at which the subject is presented, not a higher, standard or lower grade as was the case at school for the students. The following quotation supports the assertion that the student understood that the pass requirements were different:

Sipho: I think it's quite different Meneer (Mr.). Because you see here there is no higher grade and standard grade so everything's the same...because you either pass on 50% or you fail...[40].

A student indicated that at the high school, a mark between 50 and 60% was considered to be a good mark.

Thembi said that in grade eleven she did well in Mathematics. She was referring to a mark between 50 and 60%. The following quotations confirm this:

Thembi: ...Then in grade eleven I did Maths and I was doing well.

I: You did well in grade eleven?

Thembi: Yes.

I: Can you give an idea... the kind of marks that you got? Maybe % wise or...?

Thembi: 50 and 60(%) [22 – 26].

Likewise, Simphiwe believed that his performance in grade eleven was good since he obtained 91%. However, this student struggled with Mathematics in grade twelve. This statement is supported by the following quotation:

Simphiwe: When I was in standard nine, grade eleven, I was...my Maths was good, but when I was in grade twelve, I dropped, I don't know why. But I don't know why, that's why I'm not happy...(not clear)...In grade eleven, I obtained 91%...[72].

In summary, firstly, the students indicated that code-switching occurred at their high schools if their teacher spoke Xhosa. Where the teacher did not speak Xhosa, those students who worked in groups discussed the work in Xhosa. This latter practice occurred at the CPUT as well. Secondly, the students indicated that their teachers used traditional teaching methodologies. When students prepared for tests or examinations, they worked through the problems that were done by the teachers/lecturer in class. Students indicated that the pass requirements for the UT are higher than that of the schools. The inconsistent level of difficulty between successive grades was also discussed.

5.2 Theme 2: the factors influencing students' learning

5.2.1 Medium of instruction

Some students indicated that English as the medium of instruction was a problem in their learning. Bongi indicated that, for him, the language (English) was a problem. This is illustrated in the following quotation:

- I: And here at CPUT...do you find that language plays a big role?
Bongi: Yea, language is a one of the problems...yea [111 – 112].

The problems associated with communication difficulties at school were ameliorated in the following way (as discussed in section 5.1.1 of this chapter, *Communication practices*):

- (a) Where the teacher spoke English only in class, the students that made use of some form of group work in class discussed any difficulties they may have experienced with understanding what the teacher had taught them by discussing the work with each other in Xhosa.
- (b) Where the teacher also spoke the home-language of the students, the teacher switched to Xhosa to explain whatever the students may not have understood.

At CPUT, where the medium of instruction is English only, it was shown that students discussed parts of the lesson in Xhosa with their group members in order to support their learning.

5.2.2 Some issues relating to the teaching and learning of Mathematics at high school

Some students indicated that their Mathematics teachers did not cover the entire Mathematics syllabus.

Vusi indicated that certain sections of the Mathematics syllabus at high school were left out. He specifically referred to the section of Differentiation in the Mathematics syllabus. The Differentiation section of the syllabus at CPUT, contains parts of which should have been done at grade twelve level. These claims are evidenced in the following quotation:

- Vusi: Differentiation yeah...the way that we taught at my schools is not exactly the same as what we are doing...
- I: So, were there things that you did not do at school?
- Vusi: Yeah, there are things that we did not do at school...like Maxima and Minimum [116 – 118].

A student indicated that the Mathematics that he had done at school was taught in such a way that he could not meaningfully relate it to his existing knowledge of Mathematics. Thando claimed that the focus in Mathematics at school was on calculations without the teacher focusing on the meaning of the Mathematics. This claim is evidenced in the following quotation:

- Thando: Yeah, yeah...but Maths ...you calculate the gradient (derivative) but you don't even know what the gradient is but you still calculating ...(not clear) ...It was interesting when you started (at CPUT)...when you explained the gradient in the class I thought my goodness ...this is what I've been calculating for three years and I don't even know it...(laugh)...its unfortunate [52].

This student, Thando, also indicated that when he attended extra classes during the September school vacation of one week, he then only understood a particular section of Mathematics which he always had difficulty with. This claim is evidenced by the following quotation:

Thando: ...and in grade twelve in September we went to an (ex-model C) High School; we were taught there ...that was in September that year...that was the first time that I understand those graphs ...Sin, Cos graph...my whole life I didn't understand that stuff but in that week I knew that now...It was very useful... [30].

He said that if he could benefit as much as he did in one week, the benefits would be even greater if he had attended extra classes for longer periods. The following quotation supports this claim:

Thando: ...For a week and I thought goodness just imagine I spend the June (holiday) here...it was unfortunate.... [32].

A further indication of the teaching and learning practices at Thando's school was his claim that assignments were often copied amongst fellow students. Students were not concerned about what had to be learnt from the assignment. He claimed that the copying of assignments was completely ignored by the teacher and all the students received high marks despite the fact that all the assignments were the same. This is clear from the following quotations:

Thando: ...when we were given assignments...okay ...do this and I want it next week Tuesday. What we do ... everyone...if someone has the right answer you are not concerned about knowing the stuff, you just go there, copy that, go to the teacher and you got 80%, but actually you don't know the stuff

I: And your teacher didn't complain about it?

Thando: No, he couldn't be concerned about that; he didn't mention anything like that...[28 –30].

From a student's comments it is clear that the level of difficulty in Mathematics in successive grades was not consistent. A student that attained excellent marks in one grade should not necessarily struggle in the next grade.

Simphiwe claimed that he obtained high marks in grade eleven, but he struggled with Mathematics in grade twelve. This claim is evidenced by the following quotation:

Simphiwe: When I was in standard nine, grade eleven I was...my Maths was good, but when I was in grade twelve, I dropped. I don't know why. But I don't know why. That's why I'm not happy...(not clear)...In grade eleven I had obtained 91% [72].

This claim was also supported by Thando, who said that it was not necessary for him to study Mathematics in grade eight to ten, but then he struggled in grade ten to twelve. This is illustrated in the following quotation:

Thando: It was quite interesting from grade eight to grade ten...was just okay ... you don't have to study.
I: You don't have to study?
Thando: From grade eight ...I didn't have to study, but when we got to grade. ten to eleven, eleven to twelve...we were struggling [26 – 28].

A student indicated that his Mathematics teacher at school conducted weekly tests.

Andile said that he wrote a short Mathematics test every Friday. This is evidenced by the following quotation:

Andile: ...each and every Friday we are writing the test...a small test...[48].

Some of the teaching and learning (T & L) practices at schools that were identified were: non-completion of syllabi, poor teaching of content, poor assessment practices relating to the giving of assignments and inconsistent levels of difficulty between successive grades. However, some schools had (T & L) practices, such as regular test, that could be indicative of some 'good' (T & L) practices.

5.2.3 Transport and residence problems

A student indicated that if he had stayed at the school hostel his grade twelve results would have been better.

In response to a question to Andile, as to the reason why he had not obtained the grade twelve Mathematics results that he was aiming for, he replied that he did not have enough time to study because he had to walk or travel a considerable distance to and from school.

The evidence for this assertion is in the quotation below:

Andile: Because I was not staying at the school and I didn't have enough time.

I: Oh, you didn't have enough time at home to study.

Andile: I had to ... (not clear)...(I sometimes had to walk to school).

I: You used to walk to school?

Andile: Yea, when there wasn't transport. (Sometimes we had transport)

I: So you would say if...

Andile: If I had stayed there in the hostel then I should have got better [23 – 30].

In addition to the transport difficulties and the resultant waste of potential study time, Andile also indicated that he was also disadvantaged by not staying at the school hostel where he would have received support in terms of working with other students. This is evidenced by the following comment:

Andile: At high school we're living in the same village ...the guys. And then we do problems when we are at home and go back to school if we got stuck with some problems. (not clear- ask other guys) at school. But at the end ...the other two guys stayed in a hostel and I was left alone [124].

Likewise, Thembi indicated that she was inconvenienced by not staying at the CPUT hostel, as well as by transport difficulties. This claim is supported by the following quotation:

Thembi: ...then when I have to go back to school (CPUT) the bus had already left ...Then I have to take a taxi (transport problems)I am not use to that kind of life and that was ...because I hate travelling.I don't have money to travel with a bus everyday... [188].

However, she indicated that the transport difficulties did not affect her academic performance. This is evidenced in the following quotation:

- I: You don't think that transport is the biggest problem to you?
Thembi: No.
I: To what do you ascribe your performance now?
Thembi: I don't know. I just hate my performance. I don't like it [191 – 194].

Thembi is the same student that indicated that group work had no influence on her performance in Mathematics. This claim of hers was made despite the fact that she admitted that she benefited by working in groups at school. This issue is discussed in Section 5.3.2, *Improved Mathematics performance*.

5.2.4 Developing friendships and adjusting to CPUT

A student indicated that her school experience was better than her experience at CPUT because she always had students that wanted to work with her.

Thembi attended a hostel school where she had many friends, from her own class as well as from other classes to work with. This claim is illustrated in the following quotation:

- Thembi: That one (school) was better because there was students that always wanted to go and practice Maths...They always ask if you can go and do that and you go and do that...[208]; and

On the other hand, Thembi's experience at CPUT was different; she felt that her group members did not want to work with her. This is clear from the following quotation:

- Thembi: It's a bit different because you feel that other students don't want to work with you [160].

Sipho indicated that it took some time at CPUT before they (the students) got along with each other. This was because they did not know each other well enough. This is clear from the following quotation:

Sipho: At first we weren't that social with each other and we just discuss because we were close ...the desks were close, but as we got to know one other we got to trust each other then we...easy to speak to one another [34].

Thando indicated that he worked with many of the same students from grade eight to grade twelve. He described the relationship amongst these fellow students as friends. This is illustrated in the following quotation:

Thando: ...because in graded twelve the guys that I studied with I knew from grade six...so it was most like sitting with friends...so it natural to help to try to help other friends...yeah we also sit as friends...its more or less the same...[62].

5.2.5 Willingness and Motivation to seek help

Some students indicated that they were willing to ask other students for assistance when they struggled to solve certain problems.

Andile indicated that when he was unable to solve a problem that he had done at home, he would ask his group members (at CPUT) to help him the following day. This is clear from the following quotation:

Andile: If I get stuck, then I would come the following day to my (to group members) [118].

He also said that because his group members lived far from him. He went to the residence (at CPUT) to work with other students from his class. This claim is clear from the following quotation:

Andile: Then the other guy stays in Delft and the other guy stays in Phillipi and they are too far from here...then I am not too far ...I'm staying here in Kuils River. So, I used to come here with Bonggi and Siki and Xolani and... [120].

Andile also worked with different groups to assist him when his own group did not provide him with the necessary support in a subject. This claim is illustrated in the following quotation:

Andile: And in Drawings the groups are different because Drawings I work with Siki, Brenda, Mark and Bongsi.

I: Why is the group different? Is it your choice or is just happened?

Andile: Its different because I've never done...did Drawings in High School. Brenda and Mark did Drawings in high school. So, I wanted to (not clear- work with people that know) [136 – 138].

In summary, the students indicated that the medium of instruction, English, was a problem in their learning at school and at CPUT. At school the problem with language difficulties was ameliorated by code-switching practices, either by the teacher if he/she spoke Xhosa, or otherwise by peers if they worked in groups. The latter practice occurred at CPUT as well. Some students indicated that the entire grade twelve Mathematics syllabus was not covered at school, and also that the focus in Mathematics was on calculations and not on understanding. Some students indicated that they had transport and residence problems which in some cases influenced their learning. Friendship and adjusting to CPUT was a problem for some students. Finally, it was indicated that showing willingness and being motivated to seek help are also factors that can benefit learning.

5.3 Theme 3: students' positive and negative experiences of group work

5.3.1 Students assisting each other

Certain forms of assistance were identified:

- (a) weak students receiving assistance
- (b) explanations that were more detailed
- (c) mistakes picked up by peers
- (d) shorter methods which were shared
- (e) receiving immediate help
- (f) assistance in the home-language of the student

The students indicated that by working in groups they could get assistance in solving problems that was otherwise not available when they worked alone.

Some students indicated that when they worked on their own they often struggled and were also often unable to solve some of the problems. By working in a group with fellow students, these students had the opportunity to help each other solve problems. The following quotations depict these views and in particular refer to instances where students were getting assistance from fellow students:

Thembi: ...when I am alone I can't help myself...[88];

Andile: ...there are problems that I don't even know how to solve them. So then we collect minds then we can [100].

A student indicated that a peer who was struggling with Mathematics received the kind of help in the group that benefited him. In the following quotation a student refers to the group member that was struggling in the subject and who was then given help by the other group members:

Andile: Yea, because some of us in our group...Mfundo...he was struggling with Maths then we were trying to help him, and then we help him [94].

Most of the students acknowledged the fact that group work offered them the necessary support to solve Mathematics problems.

In contrast to the above cases, the student that attended an ex-model C school did not have access to such assistance at school because the students in his class were seated individually and worked on their own. This is evidenced by the following quotations:

Sipho: It was ...not the group thing. It was individual desks [14];

Sipho: You were working on your own [16].

The students indicated that the explanations available in their groups were often more detailed than that of the lecturer's. The explanations that students' got in their groups were sometimes different to that of the lecturer's and were often more detailed. The following quotation illustrates this:

Simphiwe: Yes, it worked. And I think it is useful. Because sometimes a learner...a student like you explains more than a teacher (lecturer) [40].

From these comments one can infer that the student may be referring to the lecturer's explanation of concepts or problems that usually extends only to what is necessary to do a particular problem, but that his/her explanation may not be sufficient for students struggling with basic Mathematics. The student may be struggling with basic Mathematics that is part of the high school syllabus and which would be assumed by the lecturer to have been done at school and would thus not appear in an explanation of new work done.

The students indicated that by working together in groups they shared ideas regarding problem solving.

Sipho claimed that when students worked together they shared different ways of tackling problems. The quotation that follows makes this clear:

Sipho: Yeah, I think it's quite helpful because ...you get another person's perspective on the problem when dealing with a problem [36].

Similar to the sharing of ideas of problem solving is the sharing of shorter methods of doing problems, which Thembi referred to in the following quotation:

Thembi: Maybe I don't know the easy way to when I am making some calculations but I don't know the easy way I just know the long way... then they can show me the shorter one...[100].

A student pointed out that by working together in a group they usually picked up each other's mistakes.

Simphiwe argued that when he worked alone he did not know when he had made a mistake, but when he worked in a group with his peers, his mistakes would be picked up by someone in the group. This is evident from the following quotation:

Simphiwe: For now...yeah...I get help quickly and I passed because of that. Because when there's wrong ...something that I don't understand. When you're working alone you can't even see you're making a mistake, but when you're working in groups then someone will tell you ...no, you made some mistake here [84].

In addition to having his mistakes picked up by his peers, Simphiwe also indicated that he benefited by the fact that the help he received from his peers was immediate. The student did not thus waste time continuing to work on a problem that was incorrect and also did not waste time by having to wait on the lecturer to solve the problem. In the quotation he also referred to the fact that he 'passed' because of this assistance that he received. The issue of improvement as a result of the effect of group work will be considered later in this section.

Some students said that the explanations of problems in groups were usually in Xhosa.

Sipho claimed that when someone in the group did not understand the lecturer's explanation, one of the group members would explain it in Xhosa, which might lead to a better understanding. This is evident from the following quotation:

Sipho: I usually ask the teacher, but with the group thing its also good...because if you don't understand that...maybe you did not grasp it...because it was maybe English, the peers that you're sitting with can also tell you in your own language and you ...understand better [60].

As indicated in section 5.1.1.2, *Communication amongst students*, Sipho attended an ex-model C school. It is noteworthy that he indicated that code-switching in his group at CPUT benefited him.

All the students, except one, reported that they spoke their home-language, Xhosa, in their groups at CPUT. This was despite the fact that the language of instruction at the institution was English. The reason for using their home-language was that they understood things better therewith. In response to the question:

I: The languages that you speak in your group...what is that?
Simphiwe: That is Xhosa, sir. Because we are all Xhosa. So, when something is explained in your home-language you understand it better [129 – 130].

In addition to it being their home-language and thus easier to communicate in, Simphiwe also indicated in this quotation that he understood things better in Xhosa.

5.3.2 Improved Mathematics performance

Students' actual performances in the Mathematics course will be discussed in chapter 6.

Some students claimed that the support they received by working in groups resulted in improved performances in Mathematics.

Andile asserted that his Mathematics had improved as a result of working in a group. The following quotation illustrates this claim:

Andile: Yea, it was fine...working in groups that was improved my Maths [70].

Likewise, Bongi argued that if he was seated alone he would not have performed well. This claim is evidenced by his comment:

Bongi: Yeah, if I had sat alone I don't think my marks would be better ...I think that they would be low because there are some things which I don't understand. When I study on my own there are some things that I can get struggle but through group work I get some solutions from others people as well [54].

Bongi's claim is based on the fact that if it had not been for the assistance that he received in his group, he would not have been able to solve certain problems. Thus his performance in Mathematics had most likely improved as a result of the help he received in his group. This claim by Andile and Bongi is supported by Simphiwe who likewise asserted that his performance in Mathematics had improved as a consequence of the support he received in his group. In addition to this claim, he further argued that his improved performance in Mathematics had to do with the immediate help he received in his group and the fact that his mistakes were picked up by his peers. These claims are evidenced in the following comments:

Simphiwe: For now...yeah...I get help quickly and I passed because of that. Because when there's wrong ...something that I don't understand. When you're working alone you can't even see you're making a mistake but when you working in groups then someone will tell you ...no, you made some mistake here [84].

The claims of immediate help and of mistakes being picked up by peers have been discussed earlier in this section as benefits of group work. However, in this instance it is connected to improved performance.

In contrast to the claim by some students that group work had improved their performance in Mathematics, only Thembi felt that group work had no effect on her studies and that her performance in Mathematics had to do with her own efforts only. She stated that:

Thembi: I think I would have performed the same because I was serious about my work [96].

Thembi's assertion was made with reference to her high school and to CPUT [96 & 212]. Notwithstanding this claim, in the following comment by her, she acknowledged that working in a group benefited her as opposed to if she was seated alone:

Thembi: I think for me group work was a good thing because when I am alone I can't help myself [88].

Thembi's claims are contradictory. On the one hand, she indicated that group work benefited her at high school. However, this, she claimed, did not affect her performance. At CPUT she struggled to adjust, had transport and residence difficulties and did not develop good friendships. More importantly, she felt that the group that she worked in at CPUT was not working well and was not benefiting her.

5.3.3 Dependence

Some students indicated that group work caused them to feel that they become dependent on others for their performance in Mathematics.

Bongi was concerned that by working mostly in a group he might become too dependent on others and might not be able to perform as well without the help of his group mates. This concern is illustrated in the following quotation in which he also indicated that he benefited from group work:

Bongi: Yes, it's been good but sometimes it's like I take an advantage of ...I do have people to help me. Sometimes like I don't give myself much time to...to work on my studies alone. It's like depending on other people...[62].

In this statement as well as elsewhere in section 5.3.2, *Improved Mathematics performance*, this student clearly emphasised the benefits that he received from group work. He further argued that dependence could be overcome by working in a group as well as by working alone. The following quotation supports this assertion:

Bongi: I will say...it won't be okay to work alone. It's okay to combine them...to work alone and to work with a group [160].

Likewise, Thembi was also worried that group work could cause her to become dependent on others for her learning. In the quotation that follows she argued that one should only ask for help when one needs it in order to avoid becoming dependent on others:

Thembi: I would justify my position ... If I can sit alone without knowing there's someone to help me, I'll go prepared. I would try to do things myself...then if I get stuck I will go and ask someone for help...That is what we usually do in our groups at school...you sit alone and if you don't understand something you can go there and you can form a group and discuss the issue [268].

Thembi is the same student that did not believe that group work had an effect on her Mathematics performance. Her negative disposition towards group work may also have been influenced by the way that her group functioned. This will be elaborated on in section 5.3.4, *Group Dynamics*, which follows this present discussion.

Thembi and Bongi were the only two students that were concerned that group work could cause them to become dependent on others. The other six students did not refer to dependence when asked about any negative experiences that they may have had with group work. Bongi clearly felt that group work had benefited him. The fact that he said that one should combine individual learning with group work may have satisfied his concerns.

5.3.4 Group Dynamics

A student indicated that a negative aspect of group work was when students could not get along with each other in the group.

Sipho indicated that if students in their group did not get along, it would negatively influence the workings of the group. This is evidenced by the following quotation:

Sipho: ...I think maybe if...it would have been a bit of a problem if maybe if that person...if those people that don't get along, it would...it would be a difficult to... [86].

The above comment was speculation on the part of the student in response to a question about what he disliked of group work.

In response to a question about her experience at CPUT, Thembi indicated that her group members did not want to work with her:

Thembi: It's a bit different because you feel that other students don't want to work with you. They don't want to....[160].

On the other hand, she was positive about her experience of group work at her high school because there were students with whom she worked well. This is evidenced in the following quotation:

Thembi: That one (school) was better because there was students that always wanted to go and practice Maths...They always ask if you can go and do that...[208].

The class, from which the students for the study were selected, had to form groups at the beginning of the year without the students really knowing each other well. At school, on the other hand, many of these students formed groups in earlier standards and remained together until grade twelve. This is clear from the following comment:

Thando: They both were good...because in grade twelve the guys that I studied with I knew from grade eight ...so it was most like sitting with friends...so it natural to help to try to help other friends ...yeah we also sit as friends...its more or less the same [62].

Of the eight students, only Thembi indicated that she had problems with her group members.

5.3.5 Interruptions

5.3.5.1 Digression from the topic

A student indicated that when students digressed from the topic being studied in their group it negatively influenced the workings of the group.

Bongi argued that a negative aspect of group work was that students sometimes wandered off the task that they were supposed to do and end up chatting about their holidays, and the like. This is evidenced by:

Bongi: ...It's when we are studying...what I don't like about group work is that when we are studying and somebody is saying ...come up with a topic different from when you are teaching like when you saying...during the holidays this and this happened and when you concentrate on that thing and then we forget about what has been talk in class... [164].

The time that was intended for study purposes resulted in it being a time-wasting exercise. It was not clear whether Bongi's comment referred to the in-class-workings of his group or the group work that he engaged with outside class hours as the question was asked in general.

5.3.5.2 Having to assist others

A student indicated that when he had to assist a group member, he was sometimes inconvenienced.

Vusi pointed out that he felt that his own work was sometimes slowed down when he had to assist his group members. The following comment supports this assertion:

Vusi: Yeah, sometimes I feel that but...I can't ask him but I have to help him...but sometimes I feel like...no this thing is like making me slow on my own work...

I: Does it bother you a lot?

Vusi: No, it doesn't bother me a lot [154-156].

The student did not feel that he was greatly inconvenienced by having to render assistance to a fellow student. On the other hand, most of the selected students did not consider the interruptions caused by assisting a peer as an inconvenience. One student stated that the experience of having to help a fellow student is in fact beneficial. This is clear in the following comment:

Thando: Yeah, when you help someone...you learn more by talking to a person and explaining. When you explain to him, you explain it to yourself so you know the stuff very well [68].

Instead of being an interruption, Thando considered assisting others as an opportunity to improve his own understanding of the work.

In summary, students indicated that group work helped them in the following ways: weak students receiving assistance, explanations that were more detailed, mistakes picked up by peers, shorter methods which were shared, receiving immediate help and assistance in the home-language of the student. Some students indicated that group work was the cause of their good performance in Mathematics. There were some students who were concerned that group work will result in them becoming dependent on others. Group dynamics was seen as influencing the workings of groups. Some students indicated that digression from the topic being studied and having to assist others were negative experiences of group work.

5.4 Theme 4: what group work means to the students

5.4.1 A natural process

Some students indicated that group work was a natural process in which friends worked together to help each other. By natural process I mean that friends would help each other simply because they are friends.

Thando described group work at his high school as a process that occurred naturally amongst students sitting near each other. This is evidenced in the following quotation:

Thando: Two...Two...groups formed without us even knowing we were forming but it was just the natural thing to do ... because when you sit in twos and twos (two in front and two behind) the first four is a group, the second four is a group, third four is a group, but the interesting thing is that we all facing the board [40].

He described his group as friends that have worked together from grade eight to grade twelve and because of the fact that they were friends they helped each other. This is evidenced in the following quotation:

Thando: ...because in grade twelve the guys that I studied with I knew from grade eight...so it was most like sitting with friends...so it natural to help, to try to help other friends...yeah we also sit as friends...[62].

5.4.2 Working in class and outside the class

A student indicated that he understood group work as a process in which students worked together in class as well as outside of the Mathematics classroom.

Andile indicated that his group worked together only during class hours and that the group members lived too far from each other to work together outside of the Mathematics classroom. He understood group work to be working together in classroom as well as outside the classroom. This is evidenced in the following quotation:

Andile: Here at school, we are not in groups; we are not yet in groups. Because we work as a group in the classroom and then we leave and then someone stays in Langa and another stays in ...so we don't work on the weekend. So we just work in the group during the class time [88].

He indicated that because his group members lived far from him, he went to the residence (at the UT) to work with other students from his class. This claim is evidenced in the following quotation:

Andile: Then the other guy stays in Delft and the other guy stays in Phillipi and they are too far from here...then I am not too far...I'm staying here in Kuils River. So, I used to come here with Bongzi and Siki and Xolani and...[120].

Andile's perception of group work may have been formed by his involvement with groups at high school. He indicated that at school he worked with two friends in the classroom as well as after school hours because they lived in the same area. This is evidenced in the following quotation:

Andile: At high school we're living in the same village...the guys. And then we do problems when we are at home...[124].

Since students live far apart, it makes it difficult for them to meet outside class hours. However, students at hostels may be better off in this respect.

5.4.3 Getting assistance, providing assistance or sharing

Some students viewed group work as a means of obtaining assistance from other students in Mathematics.

Simphiwe said that when he worked in a group he knew that he would get help from the other group members. This is evidenced in the following quotation:

Simphiwe: I think it's better if you in groups...I think so...when there's something you get help as quickly as you can [78].

In contrast to Simphiwe's experience, Thembi claimed that her group was not working as a group should be working. She indicated that each one in her group was doing his/her own thing and simply showed each other the answers after solving the problem. It was not a case of members trying to assist each other to understand the problem. This is evidenced in the following quotation:

Thembi: Because we're not working as a group....everyone is just working... just doing and writing down things or what....so that's the group work...
[170]

Some students viewed group work not only as a means of receiving assistance, but also giving assistance as well as sharing.

Most of the students considered group work as a process of giving and receiving assistance from group members. Vusi viewed group work as a means of sharing different ways of solving problems. He considered working together as a process whereby students learnt from each other. This is evidenced in the following quotation:

Vusi: ...and that is like where we like getting some new ideas and then we also showing them how we need to this problems [110].

Likewise Thando considered group work as a practice that benefited both, the one that provided the assistance and the receiver of the assistance. He indicated that when he explained work to a group member, he also benefited from the process. In the following quotation he claimed that when he explained a problem to a peer, he in fact understood the work better than before he explained it:

Thando: Yeah, when you help someone...you learn more by talking to a person and explaining. When you explain to him, you explain it to yourself so you know the stuff very well [68].

On the other hand, Thembi claimed that at her high school, students had to solve the problems individually and then ask for assistance. This is evidenced in the following quotation:

Thembi: We do problems individually, and then we can come and do them together. If you don't understand, you don't know how to continue with your work you have to go and ask someone [134].

In summary, some student viewed group work as a process that happens naturally in which friends worked together. One student felt that group work should not only occur in the classroom but outside the classroom as well. Some students viewed group work as a means of receiving help only. In contrast to these students, some considered group work to be a process of receiving, giving assistance and sharing.

5.5 Theme 5: the different forms of group work that students may have been engaged with at school

5.5.1 Teacher-initiated group work (formal)

Some students that engaged with group work at school indicated that their teachers initiated the group work.

Two types of teacher-initiated forms of group work were identified. In the first type, the teacher arranged the furniture in the classroom in order for students to be seated together. Bongi indicated that his teacher decided that they should work in groups and that the furniture arrangement was such that the students were required to work together. This is evidenced in the following quotation:

Bongi: Like, he...the way the class was arranged...was arranged such that people must sit in groups [30];

Although the teacher initiated the group work, the students could choose their group members. The following comment by him provides the evidence for this claim:

- Bongi: No, we put ourselves in groups.
I: You put yourselves in groups?
Bongi: I was sitting in a group with my friends [24 – 26].

This form of group work was similar to the form of group work that students engaged in at CPUT since the furniture arrangement was such that students were seated together. This is evidenced in the following quotation:

- I: OK, similar to the way that we have it here. So, the desks were put like that?
Bongi: Yeah [32 – 33].

5.5.2 Teacher-initiated group work (informal)

The second type of group work that was initiated by the teacher and which was identified from the data, was an informal form of group work. Vusi said that his teacher divided them into groups to help the weaker students with Mathematics. He also indicated that every time they did group work, they had to arrange the desks in a group so as to face each other. This is evidenced in the following quotation:

- Vusi: Yeah, we were put in a group....and he said like...we must like help others those who are doing standard grade, ...struggling with Maths [10];
No, there was no arrangement in the class; we had to sit as a group. We like formed the desks to make a group...every time [32].

Thembi also indicated that the teacher sometimes divided them into groups to work together. This is evidenced in the following:

- Thembi: Sometimes...the teacher divides us in groups...[86];
...You just sit in your own desk. Then you can form groups when there is time for that...[116].

Thus, informal group work, in these cases, occurred with students having to shift desks in order to form groups.

5.5.3. Student initiated group work

Some students indicated that the students themselves initiated the group work in their classrooms at school.

Andile claimed that at his high school, he worked with his friends who were seated near him in the classroom. This is evidenced in the following quotation:

- Andile: ...sir, with your friend next to you or it was our choice.
- I: Your choice as to whether you want to work with someone or work alone?
- Andile: Yea [60 – 62].

Likewise Thando claimed that students themselves initiated group work. In his case he considered group work as something that occurred naturally amongst students that were seated near each other in the classroom. The claim is evidenced in the following quotation:

- Thando: Two Two...groups formed without us even knowing we were forming, but it was just the natural thing to do...(not clear)...because when you sit in twos and twos (two in front and two behind) the first four is a group, the second four is a group, third four is a group...[40].

Seven of the eight students engaged in some form of group work at school. Only the student that attended an ex-model C school did not engage in any form of group work at grade twelve level. This is evidenced in the following quotation:

- Vusi: It was...not the group thing. It was individual desks.
- I: So each one sat individually- and how did you find that?
- Vusi: You were working on your own [14 & 16].

Some students indicated that they worked in groups in the classroom at CPUT in other subjects besides Mathematics.

Simphiwe: Applied Mechanics, we in groups, sir [110].

The students did the subject Applied Mechanics in the same classroom as was used for Mathematics and thus remained in the same groups. They thus had the opportunity to work together.

Some students indicated that they worked in groups outside class-time.

Xolani: Okay, in class I study with my group and outside the classes I also have some people to study with. I have a group of five...I study with them [70].

In summary, this section focussed on different forms of group work, which students may have been engaged with at school.

CHAPTER 6: DISCUSSION

6.1 Introduction

This chapter will attempt to link the findings drawn from the previous chapter to the literature review in chapter 2, as well as to the theoretical framework on student communities, which was discussed in chapter 3.

To begin with, a brief account of the community perspective (Allie et al., 2007) on student learning and how this relates to this study is given here. The three issues discussed here, are discussed in more detail under the appropriate themes in the rest of this chapter. Firstly, the perspective argues for the need by lecturers to develop an understanding of the communities from where our students come and the identities the students bring with them, and how these are similar or different to the UT community (Allie et al., 2007: 2). This study makes a contribution by building a picture of what the classroom communities, named student communities, should look like. The intervention programme at CPUT encouraged students to work in groups in class and outside the classroom as well in order to support each other's learning. Secondly, the community perspective on student learning refers to the need to build classroom communities that will prepare them for later participation in workplace communities (Allie et al., 2007: 2). However, the community perspective on student learning is currently under-developed in this regard. This study suggests what these communities should look like, and what participation entails. Thirdly, while the community perspective (Allie et al., 2007) refers to classroom communities, it is yet silent on the issue of student communities outside the classroom – this study reveals pertinent information about what these communities should look like. This study revealed that problems with transport, residence, adjusting to the UT and friendship could have an impact on student learning. By encouraging students to, not only work in groups in class, but also outside class-time students would be able to support each other's learning as well as support each other with social issues.

With respect to the five themes that were identified and analysed in chapter 5, *Analysis*, a discussion on each of these themes and its related sub-sections follows. A discussion of the theoretical perspective of this study, student communities, will be integrated into the discussion of the findings.

6.2 Theme 1: the similarities and differences with respect to the teaching and learning practices at students' old high schools compared to that at CPUT

6.2.1 Communication Practices and Medium of Instruction

“Communication Practices” and “Medium of instruction” were dealt with in separate sections in the analysis. It seems appropriate, however, to deal with them together here.

The students indicated that the medium of instruction, English, was a problem in their learning. At school, teachers who were Xhosa-speaking, switched to Xhosa when students did not understand the English explanation. If the teacher did not speak Xhosa, students that made use of a form of group work discussed the lesson in Xhosa amongst themselves. At CPUT, where the medium of instruction is English only, the students worked together in groups in the Mathematics class and conversed with each other in Xhosa whenever the English explanation of the lecturer was not clear.

The findings of the study confirm that of many studies that have shown that students, studying Mathematics and Science through the medium of English which is not the home-language, at school and at higher education institutions, are negatively affected by the medium of instruction (Barton, Chan, King, Neville-Barton & Sneddon, 2005: 722; Howie & Plomp, 2002: 12). Some of the studies indicate that students' performances in these subjects are weaker as a result of the impact of the medium of instruction on their learning (Barton, Chan, King, Neville-Barton & Sneddon, 2005: 722; Howie & Plomp,

2002: 12). My study did not evaluate the degree to which students were disadvantaged by the medium of instruction.

The findings of the study confirm Setati's (2002:14) views that code-switching is quite common in classrooms in which the medium of instruction is not the students' home-language. It also confirms the view that the students' home-language is a useful resource for learning and teaching (Setati, 2002: 14). Since I could not find any literature on code-switching at UTs, this study adds to the literature in that code-switching amongst students occurs at a UT and that code-switching is a useful learning resource for such students.

This finding on students working in groups supporting each other's language difficulties at CPUT by means of the code-switching practice, draws attention to the theoretical position of this research, student communities. This finding shows that student communities support each other's learning within the groups in the form of language support. This study therefore claims that without the support of these student communities, students would be at a language disadvantage in understanding the lecture and notes.

6.2.2 Teaching and learning practices at school and at CPUT

6.2.2.1 Teaching practices

From the comments of all eight students it can be deduced that all their teachers at school made use of a traditional Mathematics teaching methodology. The same is the case at CPUT.

6.2.2.2 Some learning practices

The students indicated that in preparation for tests at schools and at CPUT, students worked through the work that was previously done in class by their teachers.

I could not find any literature with which to compare these teaching and learning findings at UTs. This finding thus adds to the literature in this field. The experiences that students

had with group work are dealt with in section 6.4 of this chapter, *Positive and negative experiences of group work*.

6.2.3 Standards

The level of difficulty between successive grades at some schools was indicated to be inconsistent. A student obtaining an exceptionally high mark in one grade should not be struggling with the subject in the following grade, but this was the case for one student.

The students clearly did not experience a difference in teaching style and had adopted similar learning practices at CPUT compared to that at school. However, what they found different was the standards. This supports some, but not all of Mumba, Rollnick and White's (2002) claim that the differing standards of school compared to that of higher education in terms of the level of difficulty of assessments and teaching styles, have been linked to poor performances at university.

This finding also relates to the quality of teaching and learning practices at schools and therefore supports the claims that many students are poorly prepared for higher education by the school system (Pastoll, 2007; Leigh & Buffler, 2004; Campbell, Anderson & Ewer, 2003: 342).

6.3 Theme 2: factors, according to students, that influenced their learning

6.3.1 Medium of Instruction

The problems associated with communication difficulties were discussed above in the section 6.2.1, *Communication Practices and Medium of Instruction*.

6.3.2 Coverage of Mathematics syllabi at high School

The two students from the Western Cape that participated in the study both indicated that their Mathematics teachers did not cover the entire Mathematics syllabus in grade twelve. One student also claimed that the focus in Mathematics at high school was on doing calculations without considering the meanings of the concepts that were taught. A further indication of the teaching and learning practices at a student's school was a student's claim that assignments were often copied amongst fellow students. These findings confirm the claims that the majority of Black schools in South Africa do not provide for ideal learning opportunities and do not adequately prepare students for tertiary studies (HSRC, 2000; Pastoll, 2007; Leigh & Buffler, 2004; Campbell, Anderson & Ewer, 2003: 342). This study, however, does not make any assumptions about these particular students' schools since no such data were gathered. However, most of the students indicated that their Mathematics teachers conducted regular tests.

6.3.3 Social factors (Transport, residence, adjusting and friendship)

Some of the students indicated that transport and residence issues had an influence on their learning. For some, being a hostel student eliminated the problems of transport and provided the student with more opportunities to work with other students. Transportation and residence were, in particular, a problem for students from the Eastern Cape but these might affect township students as well. Many Eastern Cape students that do not find a place at the CPUT residences live with distant relatives far from the campus.

Some of the students did not develop good friendships, which made their experience at CPUT more difficult since it was difficult to get help with academic work and also because they were lonely considering that many students are from outside of Cape Town.

These findings confirm the claims that social factors: residence, transport and the issue of 'belonging' are problems that affect many students, in particular first-year students (Solomon, 2007; Pearce, 2006; Wilcox, Winn & Fyvie-Gauld, 2005; Read, Archer & Leathwood, 2003).

A side effect of the development of student communities is that of friendship within the classroom and outside. Some of the participants in the study indicated that they worked in groups outside the classroom and at student residences. Some of these students worked in the same groups throughout their high school years. These student communities may provide students, in particular those from out of town without family nearby, with support to overcome loneliness, to deal with stress, as well as to adjust to the institution, which is what the literature refers to as social integration (Solomon, 2007; Pearce, 2006; Wilcox, Winn & Fyvie-Gauld, 2005; Read, Archer & Leathwood, 2003).

6.3.4 Willingness and Motivation to seek help

Some students were keener than others to ask other students for help when they needed it. Many of these students performed quite well in most of their subjects at CPUT.

Within student communities students are provided with not only learning support but also motivational support and emotional support. These groups are also known to encourage positive attitudes towards studies and persistence at university (Smith, Sheppard, Johnson & Johnson, 2005:91; Springer, Stanne & Donovan, 1999; Moore, 2004).

6.4 Theme 3: students' positive and negative experiences of group work

6.4.1 Students assisting each other

Some of the forms of assistance that students indicated they received by working in groups were the following:

- (a) weak students receiving assistance
- (b) explanations that were more detailed
- (c) mistakes picked up by peers
- (d) shorter methods which were shared

(e) receiving immediate help

(f) assistance in the home-language of the student

This research confirms results of studies conducted at universities that argue that students are positively inclined towards group work (van Rheede van Oudtshoorn & Hay, 2004).

I could not find any literature to compare these particular findings with at UTs. This study thus contributes to the literature by listing the benefits that students derive from learning in groups at UTs.

These findings are some of the most important findings of the study. Student communities in the form of groups provide students with the range of learning support elements listed above.

6.4.2 Improved Mathematics performance

Some students claimed that the support that they received when they worked in groups had resulted in improved performances in Mathematics.

This finding confirms the outcomes of studies that the benefits of group work include gains in academic success (Smith, Sheppard, Johnson & Johnson, 2005:91; Springer, Stanne & Donovan, 1999; Moore, 2004; Potgieter & Webb, 2004).

All eight participants in the study passed Mathematics at the end of the year. Four students out of the class of thirty five failed the subject. In the old foundation model at CPUT (discussed in chapter 1, section 1.3.1 *The foundation programme at CPUT*), Mathematics was a non-credit bearing subject known as Foundation Mathematics. This would have meant that the student would have had to do the subject for the entire year without obtaining a credit. Having passed Foundation Mathematics, the student would then only do Mathematics 1 the following year. This meant that the student would take in total three semesters to obtain Mathematics 1. A higher number of students failed Foundation Mathematics in 2006 than did Mathematics 1 (ECP) this year (2007). The

reasons for the improved results could be explained in a number of ways. It could be the result of the new ECP foundation model in which all courses are now credit bearing and thus provide students with greater incentives to work hard; it could also be explained in terms of the group work intervention, a combination of these or even other factors. It is my opinion that group work played a role in the improved performances in Mathematics.

This finding, the support which student communities provide that results in improved Mathematics performances, provides strong support for the use of student communities in the form of group work to support student learning.

6.4.3 Dependence

Some students indicated that group work resulted in them feeling that they were becoming dependent on other students for their performances in Mathematics. Only two students indicated such concerns. I could not find any literature that considers dependence an aspect of group work. In this sense the study makes a contribution to the literature on group work.

The forms of support offered in groups must be taken into account, as writing down someone else's answers would not count as learning. This indicates that lecturers need to address issues that negatively influence group work.

6.4.4 Interruptions

The following two forms of interruptions in group work activities were indicated by the students:

- (a) digression from the topic being studied, and
- (b) having to assist fellow students. However, most of the students felt that they benefited by helping fellow students or that they did not mind helping fellow students.

Only one student in each case indicated that these interruptions were negative experiences of group work. I could not find any literature with which to compare these

particular findings at UTs. It may thus be a contribution to research on problems with group work.

While I have argued in favour of student communities in the form of group work, these problems suggest that student communities may need guidance to function effectively.

6.5 Theme 4: students' views on what group work means

The following were identified:

1. Group work is a natural process in which friends worked together to help each other.
2. Group work is a process in which students worked together in class and outside of the class, not only at certain times.
3. Group work is a means whereby they could get assistance from other students in Mathematics.
4. Group work is a means of not only getting assistance, but also providing assistance as well as sharing.
5. Group work is a process whereby students shared answers and this would then be followed by a discussion.

I could not find any literature to compare these particular findings with studies conducted at UTs. These findings provide useful information on students' perceptions of what group work means and in this way contribute to research in this area. The Brodie and Pournara (2005) study does provide an extensive review of research on group work practices at schools in South Africa. However, their study was not based on students' perceptions.

It is important to understand students' perception on how they view student communities. These perceptions were most likely influenced by the way that students have made use of group work at school. When implementing or encouraging student communities in the

classroom and outside of the classroom cognisance must be taken of students' perceptions. In this way the lecturer may be able to implement or support the use of student communities that students would relate to and find beneficial to their learning.

6.6 Theme 5: different forms of group work that students may have been engaged with at school

The following forms of group work used at school were identified from the interviews with students:

1. Teacher initiated group work where students sat together regularly during class times
2. Teacher initiated group work where students sat together only at certain times, such as, when students were given exercises to do in class
3. Students initiated group work in their class at school

Brodie and Pournara (2005) also make reference to forms of group work at school level in their study. However, their study relates more to the purposes rather than the forms of the group work.

These findings relate to the development of student communities at school level and thus make a contribution to the literature as it provides a means of distinguishing amongst different forms of group work. If we know what type of group work students have experienced, together with students views on group work, discussed in section 6.5, *Theme 4*, we may then plan appropriately.

7.1 Introduction

In the introduction to this study I argued that students are not adequately prepared by the school system for study at CPUT. Foundation programs are seen by many as a means by which poorly prepared students can be supported, to enable such students to cope with the programmes of the institution and thereby the institution can improve its throughput. Some universities have reported that they have had success with foundation programs. These are institutions that have track records of research in student learning and in particular foundation student learning. The fact that the CPUT foundation model had to change to an ECP format due to DoE financial pressures is a concern. I argued that it should have been through research that the institution had implemented an appropriate foundation model in the first place.

In addition to the importance of the structure of the foundation model, it is also important that the teaching and learning methodologies used on the foundation programmes be assessed in terms of their appropriateness for improving student learning. The group work intervention programme that I implemented at CPUT was an attempt in this regard.

This study occurred during the time that the group work intervention programme was implemented in the class from which the participants for the study were selected. Group work was thus an important element of the study.

During the course of this study, I have been fortunate to be involved with CREE. This grouping is involved with tertiary Engineering and Science education research and has been a valuable resource for this study. I made use of an aspect of the community perspective (Allie et al., 2007) on student learning, which I have referred to as the student communities perspective on student learning since that was an appropriate lens through which to view the data.

7.2 Response to the research question

The main question of the research was:

What issues affect foundation student learning?

Firstly, students had problems with the medium of instruction, English. Secondly, the level of difficulty between successive grades at school seemed to have been inconsistent, syllabi were not always covered in total at school. These are indicative of poor preparation for UT studies. Thirdly, social factors such as transport, residence, friendship and adjusting to the UT were all factors that affect these students negatively and could impact on their learning at the UT. I discuss these issues in more detail under the sub-questions that follow.

The sub-questions of the research and the responses to them are listed here:

1. What teaching and learning experiences did students have at their high schools?
How different were these experiences at CPUT? What issues do students believe affected their learning?

The study provided data on communication practices, certain teaching and learning practices and the standards (level of difficulty) of schools. Similar data were available on the students' CPUT teaching and learning experiences. The students referred to code-switching practices at school to support their communication difficulties. Group work was also considered to be beneficial in supporting students who had communication difficulties at school and at CPUT. Students indicated that their teachers all made use of traditional teaching methodologies when teaching Mathematics. Students also indicated that their Mathematics teachers conducted regular tests. Some inconsistent practices were reported by some students, such as the level of difficulty between successive grades.

The students also indicated that their learning was affected by the medium of instruction, transport and residence problems, coverage of the Mathematics syllabi at the high school,

developing friendships and adjusting to CPUT, as well as by their own willingness and motivation to seek help with their studies.

2. What experiences do students have of group work at school? Do students feel that group work benefits their learning? If it does benefit their learning, in what way?

Seven of the eight participants engaged with some form of group work at school. The exception was an ex-model C student. All the students indicated that the group work at school was beneficial to their learning. At CPUT these students studied Mathematics in a group work intervention programme. Seven of the eight students' at CPUT indicated that group work supported their learning. The support ranged from assistance with the medium of instruction, English, and assistance in solving Mathematics problems. Some of the students indicated that they performed well in Mathematics because of the assistance that they received in their groups.

3. Is the student communities perspective a useful perspective to describe foundation student learning?

Yes, the perspective was useful. This study focussed on the student communities perspective since it was a useful way to describe the learning of the participants in the research. Group work formed an important aspect of students' learning at school and subsequently in the intervention programme at CPUT. The student communities perspective is based on the community perspective on learning.

7.3 Implications for practice at CPUT

An understanding of student learning, in particular, the factors that influence student learning is important for teaching and learning practice. Being aware of students' difficulties with English means that one has to take action to ameliorate the situation.

Code-switching amongst students has been shown to support students with these difficulties. This is in particular important since the medium of instruction is English. This implies that one should encourage students to develop student communities in class and outside the class, such as group work, to assist each other with language difficulties.

I have argued that a large percentage of students are poorly prepared for studies at tertiary institutions. This has implications for teaching and learning practices. From the teaching point of view, I will have to take into account the areas of work that have not been adequately covered at school. Sometimes one can find out what sections of work have not adequately been covered by watching students work on problems in class. One may have the time to cover some aspects in class, but students must be made aware of the necessity to understand the work and the need for them to catch up. Assistance should be provided, possibly in the form of extra tutorials. Group work has been shown to support student learning at school as well as at CPUT. In this regard group work provides support to students in general but in particular to those students who are poorly prepared for study at a UT. Since adequate tutors are not always available, the use of group work can be of great value.

The study has informed me of what types of group work students have experienced and of their perceptions of what group work is. This I can use to evaluate my current implementation of group work and thereby make it more effective.

The study has also informed me of certain possible negative aspects of group work, like dependency on other students for their learning as well as interruptions during group work times. These are issues on which students should be guided to enable groups to function effectively.

It has also been shown that social problems affect many students at CPUT. Group work could provide these students with support to handle social issues better, and give them a sense of belonging. Students must be made aware of the usefulness of group work

activities at UTs and that they can all benefit by working within student communities in class and outside the class.

At an institutional level, programme planners should understand students' readiness for tertiary study and have an institutional plan to guide faculties and departments.

7.4 Theoretical contributions

The theoretical framework used to interpret the data of the study was the student communities perspective on learning. The student communities perspective is an aspect of the community perspective on student learning which CREE developed in response to the poor throughput rates at tertiary institutions in South Africa (Allie et al., 2007: 2).

The data for the study reflected these communities in terms of the fact that group work formed an integral part of student learning at school and at CPUT. The intervention programme at CPUT encouraged students to work in groups in class as well as outside the classroom in order to support each other's learning.

This study makes a contribution by describing what the classroom communities should look like.

7.5 Methodological issues

This was a qualitative interview study which was intended to investigate students' real experiences of learning at school and at CPUT. Since this is a master's degree study and my first research study, the entire process was a new experience which was guided by my supervisors. In this section I reflect on my research journey, and in particular on what I feel are the strengths and weaknesses of my study.

At the start of this study, my intention was to make the focus of the study the use of group work at a UT and the evaluation of the intervention programme. However, it

became clear that group work on its own could not respond to the learning problems faced by students. The focus of the research thus changed to the issues affecting student learning. Group work became an aspect of the research and not the main focus. This had implications for the literature review, since most of the literature that I reviewed related to group work. Thus with the changed focus, the literature review process, except for some group work literature, had to be done from scratch again. The renewed focus had implications for the research questions as well. I had to develop new research questions for the study based on its renewed focus. This is part of the process of research.

Since this was a qualitative study, issues of quality were important and thus each process had to be scrutinised for its trustworthiness. Each aspect of the research was a process of growth which included reflecting on how, for example, an interview transpired and what I could do to improve the next interview. There were times that the replay of tape-recordings with an analogue transcriber was unclear which made transcriptions a difficult task. In hindsight, I should have made the effort to acquire a digital transcriber to avoid something that could have had implications for the quality of the research. I was both the interviewer and transcriber and I did all the transcriptions on the same day on which the interviews were conducted. This was of great benefit, in particular, with tape-recordings that were at times unclear.

Students' communication skills had implications for the study. In selecting students for the study I did not consider students whose communication skills were such that making meaning in a conversation would be difficult. This in hindsight I think was a correct decision. Even with the selected participants were meaning making at times difficult. However, I believe that even in these cases the transcripts and analysis were true reflections of their stories.

7.6 Personal Reflections

Since I discussed my role in this research in chapter 1, section 1.2, *The researcher*, I consider it appropriate to pass a few reflective comments at the end of the study. As was indicated in that section, the research focus changed as a result of getting to know the circumstances that were involved in the learning of the students. In this way I got to know the issues that affected students' learning much better.

I think that as a result of the research, I am in a much better position than before, to deal with the teaching and learning issues of foundation students, as well as to implement suitable intervention strategies.

I have also learnt that the research process is not always linear. Trying to research the complexity of teaching and learning settings often involves changing and developing things as the study proceeded. As a researcher, the research experience has been a fruitful one. It has taken me from a situation of having little interest in research to understanding the value of research and the importance, in particular, of qualitative research. The study has also reinforced my belief in the importance of research to inform practice. The issue of foundation programmes is a case in point, where programmes are designed without taking into account research and the consequences, in my opinion, lead to programmes that will not address the issues of throughput.

7.7 Recommendations

7.7.1 Teaching and learning

- Lecturers need to take account of their students' poor preparation for study at a UT, for example poor problem solving skills, and adapt their courses to enable students to develop these skills. This does not imply lowering of standards, but that students are assisted to overcome their disadvantage.
- Lecturers need to understand that student learning, for students whose home-language is not English, is negatively affected by the medium of instruction. Students should be

made aware of their disadvantage. Lecturers should encourage their students to assist each other by discussing the work in their home-language.

- This study has argued that group work is a practice that many students have engaged with at school to support their learning. By making use of group work in their classes, lecturers would provide such students and other students with support in class. Students should also be encouraged to work in groups outside the class.
- Other lecturers on the foundation programme should be encouraged to implement group work in their subjects.

7.7.2 Further research

- This study addressed general issues of teaching and learning, but the focus has been on the use of group work. This study argued for the use group work and thus encourages lecturers to use it as well. However, further research is required on other teaching and learning practices specifically for foundation programmes, for example, further strategies to help second language English students. It is essential that one implement teaching and learning strategies that would benefit the particular setting.
- No data was collected regarding students' personal circumstances and the particular schools attended by the students. This might be considered a weakness in the study since I have argued in the study from the point of view that the students were disadvantaged because they have attended township schools and lived in township or rural areas. There are instances of the poorest-resourced township and rural schools that perform equivalently to the better-resourced township or rural school (Taylor, Muller & Vinjevold, 2003: 130). A study taking into account the socio-economic status of students and the schools attended would certainly paint a fuller picture.

7.8 Final comments

It is hoped that this study will contribute to the need for research in the area of student learning, in particular that of foundation student learning at UTs. It is the responsibility of all stakeholders; the DoE, higher education institutions, departments and lecturers to all play a positive role in the difficulties faced by higher education institutions regarding access, retention and throughput.

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APPENDIX 1: Questionnaire

This questionnaire forms part of a research study into student learning. The purpose is to find out about your educational background and issues that influence your educational progress. All the information will be confidential.

1. Name the area in which you stay (your permanent address).
2. Name the area in which you stay whilst studying. Also specify if it is a hostel.
3. (a) What is the name of the primary school that you attended?
(b) In which area is the school located?
4. (a) What is the name of the high school that you attended and also the high school at which you wrote your grade twelve exit examinations?
(b) In which area is the school located?
5. (a) What languages do you speak?
(b) What language do you speak at home?
(c) What languages did your Mathematics teacher use in class at high school?
(d) What languages did students use in your Mathematics class at high school?

APPENDIX 2: Interview questions (semi-structured)

The students should be briefed about the purpose of the interview and study. Even though cooperative learning was introduced with the expressed intention to assist student learning, the interviewer/lecturer/researcher requires students' to state their views as honest as possible as it is important to the study.

1. Can you tell me about your old high school?
2. Can you compare your experience at your old high school with the situation here at CPUT in the way that you learn Mathematics? {ways of T & L by teachers and students, interactions/conversations in class – both teacher-students and student-student, any group work; follow-up questions ... }
3. How do you study/learn Maths? How do you prepare for tests and exams? Any different now compared to high school?
4. Can you tell me in broad detail of your experiences over the past 6 months of working in groups/cooperative learning in the Mathematics class?
5. When you do not understand a concept or problem, what do you do? {Do they just copy from one of the others or are their explanations involved? Or ...}
6. How do you respond to a group member asking for help to solve a problem? How does it make you feel?
7. (a) What languages do you use in your group and why?
(b) If the language is not English: Why do you speak in that language?
 - not language of instructions
 - easy because of home language, to understand concept?
8. Do you work cooperatively in other subjects?
9. Learning outside the classroom – homework and studying: How do you study?
10. Do you think that you would work better if you had sat alone, instead of a group?